



APPENDIX 'A'
SPECIFICATIONS

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1.0 GENERAL

- .1 Section 01535 addresses general requirements for temporary utilities and construction facilities not incorporated into the final or permanent work. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 Comply with General Conditions, Clauses 4.4, Temporary Structures and Facilities.

1.1 Section Includes

- .1 Temporary utilities.
- .2 Construction facilities.
- .3 Office and sheds.
- .4 "Portaloos"
- .5 Project identification.

1.2 Installation and Removal

- .1 Provide temporary utilities and construction facilities in order to execute work expeditiously.

1.3 Dewatering

- .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

1.4 Sanitary Facilities

- .1 Provide sufficient sanitary facilities for workers in accordance with local health authorities.

1.5 Water Supply

- .1 Provide adequate supply of potable water.

1.6 Site Storage/Loading

- .1 Confine work and operations of employees in accordance with Contract Documents. Do not unreasonably encumber premises with products. Areas off the end of Cub and Cinnamon Streets shall be available to the Contractor for construction staging, including materials lay-down, provided areas occupied by the Contractor for such use are not damaged. Such areas will be limited and shall be agreed with the Community representative prior to their initial use.

- .2 Do not load or permit to load any part of work with a weight or force that will endanger the work.

1.7 Temporary Power and Light

- .1 Arrange for connection with appropriate utility company. Pay all costs for installation, maintenance, and removal.

1.8 Construction Parking

- .1 On-site parking will only be permitted if it does not disrupt the movements of the citizens or the performance of the work. Otherwise parking shall be as indicated in 1.6 above.

1.9 Hoarding

- .1 Provide hoarding as shown on Contract Drawings protecting public and private property from injury or damage. Lockable gates are not specifically required for access to the site.

1.10 Security

- .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

1.11 Site Offices

- .1 The Contractor is not specifically required to provide a Contract Administrator's office for the site.
- .2 If supplied, provide and maintain in clean condition during progress of work, adequately lighted, heated, and ventilated Contractor's office with space for filing and layout of Contract Documents and Contractor's normal site office staff.

1.12 Construction Sign

- .1 Provide and erect, within 3 weeks of signing Contract, a project sign in a location designated by Contract Administrator.
- .2 Construction sign 1.2m x 2.4m, of wood frame and plywood construction painted with exhibit lettering produced by a professional sign painter.
- .3 Indicate on sign, name of Owner, Contract Administrator, and Contractor, of a design style approved by Contract Administrator.

.4 Maintain sign in good condition for duration of work.
Clean periodically.

.5 No other sign or advertisements, other than warning
signs, are permitted on site.

1.13 Public Notice

.1 Advise residents and/or other parties within the affected
area of planned construction activities and schedule.
Coordinate with and obtain Contract Administrator's
approval before delivery or mailing of public notices.

1.14 Site Access

.1 It may be necessary to remove the fence at the ball
diamonds to access and execute the work. If this is so,
the fence shall be carefully removed and replaced on
completion of the underground work to an equal or better
condition than before the work began. If this cannot be
achieved, replace the fence as required.

1.15 Site Conditions

.1 Take detailed photographs of all parts of the work and
provide to the Contract Administrator electronically prior
to any work commencing - as a record of existing site
conditions. Take additional photographs if required by
the Contract Administrator.

1.16 Payment

.1 Payment for all work performed under this Section will
be incidental to payment for work described in other
Sections unless shown otherwise in the Schedule of
Quantities and Prices.

2.0 PRODUCTS

NOT USED

3.0 EXECUTION

NOT USED

1.0 GENERAL

- .1 Section 01561 addresses general requirements for environmental protection. This section is not intended to identify all and/or specific requirements. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 Comply with General Conditions, Clause 20.4, Environmental Laws.

1.1 Fires

- .1 Fires and burning of rubbish on site not permitted without approval of the Contract Administrator. All fires to conform to Provincial and Municipal regulations.

**1.2 Disposal of
Wastes**

- .1 Do not bury rubbish and waste materials on site unless approved by Contract Administrator.
- .2 Do not dispose of waste or volatile materials, such as mineral spirits, oil, or paint thinner into watercourses, storm, or sanitary sewers.

1.3 Drainage

- .1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.
- .2 Do not discharge water containing suspended materials into watercourses, sewer, or drainage systems.
- .3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with Federal, Provincial, and Municipal requirements.

**1.4 Site Clearing and
Plant Protection**

- .1 Protect trees and plants on site and adjacent properties where shown on Contract Drawings.
- .2 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping, and storage of materials over root zones.
- .3 Minimize stripping of topsoil and vegetation.
- .4 Restrict tree removal to areas indicated or designated by Contract Administrator.

**1.5 Work Adjacent to
Watercourses**

- .1 Work around watercourses shall be done in accordance with the most recent version of the “Land Development Guidelines” published by the Provincial Ministry of Environment Lands and Parks.
- .2 Do not operate construction equipment in watercourses.
- .3 Do not use watercourse beds for borrow material without approval from Federal, Provincial, and Municipal Authorities.
- .4 Do not dump excavated fill, waste material, or debris in or adjacent to watercourses.
- .5 Design and construct temporary crossings to minimize erosion to watercourses.
- .6 Do not skid logs or construction materials across watercourses.
- .7 Avoid spawning beds when constructing temporary crossings of watercourses.
- .8 Do not blast under water or within 100m of spawning beds without approval from Federal, Provincial, and Municipal authorities.

1.6 Pollution Control

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant to local authorities emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.7 Payment

- .1 Payment for all work performed under this Section will be incidental to payment for work described in other

Sections unless shown otherwise in the Schedule of Quantities and Prices.

1.8 Inspection and Testing

- .1 Refer to General Conditions, Clause 4.12, Inspections.

2.0 PRODUCTS

2.1 Silt Barrier Fence

- .1 Silt fence to be manufactured from a woven, silt film geotextile material with a shiny to smooth surface texture designed to reduce velocity of runoff to point that suspended particles settle out due to reduction of hydraulic energy.

- .2 Minimum Requirements:

PROPERTY	VALUE
Grab Tensile	500N
Mullen Burst	1900kPa
Elongation at Break	25% Maximum
Opening	600µm maximum
U.V. Rating @ 500hrs	90% Retained
Efficiency	> 75% minimum
Construction	Woven (tape)
Texture	Smooth, Shiny
Posts	4 x 4 cm, treated
Post Spacing (centres)	2 meter maximum
Permittivity	10L/s/m ²
Above values are "Minimum Average Roll Values"	

3.0 EXECUTION

3.1 Placement

- .1 Place silt barrier in a manner that will intercept runoff at or close to right angles to flow. In areas where problem is severe, erect two or more silt barriers parallel to each other, until required degree of control is achieved.
- .2 Fence height as specified on Contract Drawings.
- .3 Position posts in such a manner that fence structure remains naturally taut and placed or driven a minimum of

500mm into ground. Posts to always be positions downstream.

- .4 Where a 500mm depth is impractical or impossible adequately secure or brace posts to prevent overturning of fence due to sediment loading.
- .5 Bury excess geotextile at bottom of silt fence minimum of 150mm in trench located upstream such that no flow can pass under fence.
- .6 Splice subsequent lengths of barrier only at support post locations. Splice by wrapping geotextile fabric completely around each of two abutting support posts, as detailed on Contract Drawings, such that gap between abutting posts is completely covered by both sections of fabric.

3.2 Quantities

- .1 Limit silt fence to handle area equivalent to maximum 100m² per 3m of fence.
- .2 Do not use where site slope is steeper than 3:1, and water flow rates exceed 0.03m²/s per 3m of fence.
- .3 Silt barrier to have efficiency > 75%. Employ successive parallel fences to achieve required degree of control.

3.3 Maintenance

- .1 maintain integrity of silt fences as long as necessary to contain sediment runoff. Inspect all temporary silt fences immediately after each rainfall and at least daily during prolonged rainfall. Immediately correct any deficiencies. In addition, make daily review of location of silt fences in areas where construction activities have changed natural contours and drainage runoff to ensure that silt fences are properly located for effectiveness. Where deficiencies exist, install additional silt fences. Should silt fence become damaged or otherwise ineffective while barrier is still necessary, repair or replace promptly.
- .2 Remove sediment deposits when deposit reaches approximately one-third of height of silt fence or install second silt fence upslope.

- .3 Do not remove silt fence until Contract Administrator directs that it be removed.

3.4 Clean Up

- .1 At completion of construction phase or as directed by Contract Administrator, remove and dispose of any silt accumulations, dress area to give a pleasing appearance, and vegetate all bare areas as specified in Supplementary Specifications or as shown on Contract Drawings.

1.0 GENERAL

- .1 Section 01570 addresses the general requirements for accommodation of roadway traffic during construction. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 During progress of the Works, make adequate provision to accommodate normal traffic along streets and highways immediately adjacent to or crossing the Works so as to cause minimum of inconvenience to general public.
- .3 Give minimum 48hr notice or as otherwise required by local bylaws to local police, fire departments, emergency services, and municipal works authorities prior to beginning construction and comply in all respects with their requirements.
- .4 Inform all owners or occupants of properties where access is affected in advance of proposed road and/or sidewalk closures.
- .5 The Regional District of Fraser Fort George has a permit from the Ministry of Transportation to undertake utility works within a highway right of way. The contractor shall comply with the requirements of the permit and with the requirements of MoT for the work of this contract generally.

1.1 Reference Standard

- .1 Regulate traffic in general accordance with municipal requirements except where specified otherwise and in compliance with specific requirements stipulated herein.

1.2 Protection of Public Traffic

- .1 Comply with requirements of the "Traffic Control Manual for Work on Roadways", published by the British Columbia Ministry of Transportation and Highways, for regulation of vehicle and pedestrian traffic or use of roadways upon or over which it is necessary to carry out work or haul materials or equipment.
- .2 When working on travelled way:

- .1 Place equipment in position to present minimum of interference and hazard to travelling public.
- .2 Keep equipment units as close together as working conditions will permit and preferably on same side of travelled way.
- .3 Do not leave equipment on travelled way overnight.
- .3 Do not close any lanes of road or highway without approval of Contract Administrator. Before re-routing traffic erect suitable signs and devices as approved by the Contract Administrator. Provide sufficient crushed gravel to ensure a smooth riding surface during work.
- .4 Keep travelled way well graded, free of pot holes, and of sufficient width that required number of lanes of traffic may pass.
- .5 When directed by Contract Administrator, provide well graded, gravelled detours or temporary roads to facilitate passage of traffic around restricted construction area. Provide and maintain signs and lights and maintain roadway.
- .6 Provide and maintain reasonable road access and egress to property fronting along or in vicinity of work under contract unless approved otherwise by Contract Administrator.

**1.3 Informational and
Warning Devices**

- .1 Meet with Contract Administrator prior to commencement of work to prepare list of signs and other devices required for project.
- .2 Provide and maintain signs and other devices required to indicate construction activities or other temporary and unusual conditions resulting from project work which may require road user response.
- .3 Supply and erect signs, delineators, barricades, and miscellaneous warning devices in accordance with Municipal requirements.
- .4 Place signs and other devices in additional locations as appropriate or as directed by Contract Administrator.

- .5 Continually maintain traffic control devices in use by:
 - .1 Checking signs daily for legibility, damage, suitability, and location. Clean, repair, or replace to ensure clarity and reflectance.
 - .2 Removing or covering signs which do not apply to conditions existing from day to day.

1.4 Control of Public Traffic

- .1 Provide flag persons, trained and properly equipped in following situations:
 - .1 When public traffic is required to pass working vehicles or equipment which may block all or part of travelled roadway.
 - .2 When it is necessary to institute one-way traffic system through construction area or other blockage where traffic volumes are heavy, approach speeds are high and traffic signal system is not in use.
 - .3 When workmen or equipment are employed on travelled way over brow of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.
 - .4 Where temporary protection is required while other traffic control devices are being erected or taken down.
 - .5 For emergency protection when other traffic control devices are not readily available.
 - .6 In situations where complete protection for workmen, working equipment, and public traffic is not provided by other traffic control devices.
 - .7 At each end of restricted sections where pilot cars are required.
- .2 Provide pilot cars where public traffic must use particularly hazardous routes or where traffic is required to remain in one lane or change periodically from one lane to another or negotiate sections of construction at restricted speed. Equip pilot cars with orange flashing lights and signs clearly designating vehicles as pilot cars.
- .3 Provide and maintain suitable detours or temporary access routes for pedestrian traffic, complete with suitable warning and advisory signs.

- .4 Maintain existing conditions for traffic throughout period of contract except that, when required for construction under contract and when measures have been taken as specified herein and approved by Contract Administrator to protect and control public traffic, existing conditions for traffic may be restricted.

1.5 Payment

- .1 Payment for all work performed under this Section will be incidental to payment for work described in other Sections unless shown otherwise in the Schedule of Quantities and Prices.

2.0 PRODUCTS

NOT USED

3.0 EXECUTION

NOT USED

- 1.0 GENERAL**
- .1 Section 01721 addresses general requirements for submittal of operating and maintenance manuals. This section must be referenced to and interpreted simultaneously with all other sections pertinent to works described herein.
- 1.1 Section Includes**
- .1 Record documents, samples, and specifications.
- .2 Equipment and systems.
- .3 Products data, materials and finishes, and related information.
- .4 Operation and Maintenance data.
- 1.2 Related Sections**
- .1 Individual Specifications: Specific requirements for operation and maintenance data.
- 1.3 Submission**
- .1 Prepare instructions and data by personnel experienced in maintenance and operation of description products.
- .2 Submit one copy of completed volumes in final form 15 days prior to date of performance.
- .3 Copies will be returned within 15 days after date of total Performance
- .4 Revise content of documents as required final submittal.
- .5 Two weeks after receipt of Contract Administrator's comments submit to Contract Administrator, three final copies of operating and maintenance.
- 1.4 Format**
- .1 Organize data in form of instructional manual.
- .2 Binders: 3-ring, hard cover.
- .3 When multiple binders are used, correlate data into related consistent groupings.
- .4 Cover: identify each binder with printed title; list title of Project, identify subject matter of contents.

- .5 Include Table of Contents.
- .6 Provide tabbed flyleaf for each separate section.
- .7 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of pages.

1.5 Contents, Each Volume

- .1 Table of Contents: provide title of project; names, addresses, and telephone numbers of Consultant and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
- .2 For each product or system: list names, addresses, and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

1.6 Record Documents and Samples

- .1 Maintain at site for Contract Administrator one record copy of all Contract Documents including:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Field Memos.
 - .4 Addenda.
 - .5 Change Orders.
 - .6 Reviewed shop drawings, product data, and samples.
 - .7 Field test records.
 - .8 Inspection certificates.
 - .9 Manufacturer's certificates.

- .2 Store record documents and samples in site office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label and file in accordance with relevant Section number. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain Record Documents in a clean, dry and legible condition. Do not use Record Documents for construction purposes.
- .5 Keep Record Documents and samples available for inspection by Contract Administrator.

1.7 Recording Actual Site Conditions

- .1 Record information concurrently with construction progress. Do not conceal work until required information is recorded.
- .2 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .2 Field changes of dimension and detail.
 - .3 Changes made by Addenda and Change Orders.
 - .4 Details not on original Contract Drawings.
 - .5 References to related shop drawings and modifications.
- .3 Specifications: legibly mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each project actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and Change Orders.
- .4 Other Documents: maintain manufacturer's certifications, inspection certifications, and field test records, required by individual specifications sections.

1.8 Payment

- .1 Payment for all work performed under this Section will be incidental to payment for work describe in other Sections unless shown otherwise in the Schedule of Quantities and Prices.

2.0 PRODUCTS

N/A

3.0 EXECUTION

N/A

1.0 GENERAL

- .1 The Specifications contain references to standard specifications for testing, materials, manufacturing and installation procedures. These references have been abbreviated to identify only the referenced Association and specification designation. This section provides the full descriptive title of each referenced specification.
- .2 When references to capitalized abbreviations are made, they refer to Specifications, Standards, or Methods of the respective Association. Abbreviations listed herein but not mentioned in the specifications shall be disregarded.
- .3 The numbers & letters following the abbreviations denote the Association's serial designation for the Specification or Standard to which reference is made.
- .4 References to these Specifications, Standards or Methods shall be understood to refer to the latest adopted revision, including all amendments.
- .5 The specifications and standards published by these organizations and other specified specifications and standards referred to in these Specifications are hereby made part of these Specifications as far as they are applicable to and not inconsistent with these Construction Specifications.
- .6 Make available on site all references relevant to the works for ready reference by the Contractor and the Contract Administrator.

3.1 Nomenclature

- | | | |
|----|-------------------|--|
| .1 | AAFC | Agriculture and Agri-Food Canada |
| .2 | AASHTO | American Association of State Highway & Transportation Officials |
| .3 | ACI | American Concrete Institute |
| .4 | AI | Asphalt Institute |
| .5 | ANSI | American National Standards Institute American |
| .6 | ASTM | Society of Testing and Materials American |
| .7 | AWWA | American Water Works Association |
| .8 | BCLNA | BC Landscape and Nursery Association |
| .9 | BCMOT
E&SMS V1 | BC Ministry of Transportation Electrical and Sign Material
Specification Volume 1 |

.10	BCH	British Columbia Ministry of Transportation and Highways
.11	CAN	Prefix signifying endorsement of other current standard as a Canadian National Standard
.12	CCIL	Canadian Council of Independent Laboratories
.13	CCTV	Closed Circuit Television
.14	CEC	Canadian Electrical Code
.15	CGSB	Canadian General Standards Board
.16	CSA	Canadian Standards Association
.17	C-SHRP	Canadian Strategic Highway Research Program
.18	IMSA	International Municipal Signal Association
.19	JPEG	Joint Photographic Experts Group
.20	LCD	Liquid Crystal Display
.21	LED	Light Emitting Diodes
.22	MPEG-2	Moving Picture Experts Group standard for transmitting digital video and sound in compressed format
.23	MSCC	Manual of Sewer Condition Classification – Third Edition 1993 including Addendum – February 1996
.24	MUTCDC	Manual of Uniform Traffic Control Devices of Canada
.25	NAAPI	North American Association of Pipeline Inspectors
.26	NACE	National Association of Corrosion Engineers
.27	NASCO	National Association of Sewer Service Companies
.28	NCHRP	National Cooperative Highway Research Program
.29	NEMA	National Electrical Manufacturer's Associations
.30	WRc	Water Research Centre

3.2 Referenced Specifications

.1	ACI	
.1		ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure
.2	AI	
.1		Asphalt Institute Manual SP-2 Superpave Level 1 Mix Design
.3	ANSI	
.1		ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
.2		ANSI B16.5, Pipe Flanges and Pipe Fittings.

- .4 ANSI/ACI
 - .1 ANSI/ACI 117, Tolerances for Concrete Construction and Materials.
 - .2 ANSI/ACI 315, Details and Detailing of Concrete Reinforcement.
- .5 ANSI/AWWA
 - .1 ANSI/AWWA B300, Hypochlorites.
 - .2 ANSI/AWWA B301, Water Treatment- Liquid Chlorine.
 - .3 ANSI/AWWA C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - .4 ANSI/AWWA C105/A21.5, Polyethylene encasement for Ductile-Iron Piping for Water and Other Liquids.
 - .5 ANSI/AWWA C110/A21.10, Ductile-Iron and Gray Iron Fittings, 3 inches through 48 inches for Water and Other Liquids.
 - .6 ANSI/AWWA C111/A21.11, Rubber Gasket Joints for Ductile-Iron and Gray Iron Pressure Pipe and Fittings.
 - .7 ANSI/AWWA C150, Thickness Design of Ductile-Iron Pipe.
 - .8 ANSI/AWWA C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds for Water or other Liquids.
 - .9 ANSI/AWWA C153/A21.53, Ductile-Iron Compact Fittings, 3 inches through 16 inches, for Water and Other Liquids.
 - .10 ANSI/AWWA C200, Water Pipe 6 inches and Larger, Steel.
 - .11 ANSI/AWWA C203, Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied .
 - .12 ANSI/AWWA C205, Cement Mortar Protective Lining and Coating for Steel Water Pipe - 4 inches and larger- Shop Applied.
 - .13 ANSI/AWWA C206, Field Welding of Steel Water Pipe.
 - .14 ANSI/AWWA C207, Steel Pipe Flanges for Waterworks Service, 4 inches through 144 inches.
 - .15 ANSI/AWWA C208, Fabricated Steel Water Pipe Fittings, Dimensions for.
 - .16 ANSI/AWWA C210, Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
 - .17 ANSI/AWWA C213, Fusion-bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
 - .18 ANSI/AWWA C219, Bolted, Sleeve-type Couplings for Plain-end Pipe
 - .19 ANSI/AWWA C301, Prestressed Concrete Pressure Pipe Steel Cylinder Type for Water and Other Liquids.

- .20 ANSI/AWWA C303, Reinforced Concrete Pressure Pipe Steel Cylinder Type, Pretensioned for Water and Other Liquids.
- .21 ANSI/AWWA C500, Gate Valves for Water and Sewage Systems.
- .22 ANSI/AWWA C502, Dry-Barrel Fire Hydrants.
- .23 ANSI/AWWA C504, Butterfly Valves.
- .24 ANSI/AWWA C508, Swing-check Valves for Waterworks Service, 2in (50mm) through 24in (600mm) NPS.
- .25 ANSI/AWWA C509, Resilient-Seated Gate Valves for Water and Sewerage Systems.
- .26 ANSI/AWWA C510, Double Check Valve Backflow-Prevention Assembly
- .27 ANSI/AWWA C511, Reduced-pressure Principle Backflow-prevention Assembly.
- .28 ANSI/AWWA C512, Air Release Air/Vacuum and Combination Air Valves for Waterworks Service.
- .29 ANSI/AWWA C550, Protective Epoxy Interior Coating for Valves and Hydrants.
- .30 ANSI/AWWA C600, Installation of Ductile-Iron Water Mains, and their Appurtenances .
- .31 ANSI/AWWA C602, Cement Mortar Lining of Water Pipelines - 100 mm and larger - In Place.
- .32 ANSI/AWWA C605, Underground installation of Polyvinyl Chloride (PVC) pressure Pipe and Fittings for water.
- .33 ANSI/AWWA C651, Disinfecting Watermains.
- .34 ANSI/AWWA C800, Underground Service Line Valves and Fittings.
- .35 ANSI/AWWA C900, Pressure Pipe, 4 inches through 12 inches for Water, Polyvinyl Chloride (PVC).
- .36 ANSI/AWWA C901, Polyethylene (PE) Pressure Pipe and Tubing, 1/2 inch through 3 inches for Water Service.
- .37 ANSI/AWWA C902, Polybutylene (PB) Pressure Pipe and Tubing, 1/2 inch through 3 inches for Water Service.
- .38 ANSI/AWWA C905, Pressure pipe and fittings, 4 inches through 63 inches for Water Distribution
- .39 ANSI/AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4 inches through 63 inches, for Water Distribution.
- .40 ANSI/AWWA C907, Standard for Polyvinyl Chloride (PVC) Pressure Fittings for Water - 4 inches through 8 inches.
- .41 ANSI/AWWA M17, Installation, Field Testing, and Maintenance of Fire Hydrants.
- .42 ANSI/AWWA M23, PVC Pipe- Design and Installation.
- .43 ANSI/AWWA M41, Ductile-Iron Pipe and Fittings.

.6 ASTM (A)

- .1 ASTM A36, Standard Specification for Structural Steel.
- .2 ASTM A48, Specification for Gray Iron Castings.
- .3 ASTM A53, Specification for Pipe, Steel, Black - and Hot-Dipped, Zinc-Coated, Welded and Seamless
- .4 ASTM A90, Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles .
- .5 ASTM A 120, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses
- .6 ASTM A 121, Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
- .7 ASTM A283/A283M, Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars.
- .8 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
- .9 ASTM A325, Standard Specification for High-Strength Bolts for Structural Steel Joints.
- .10 ASTM A354, Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.
- .11 ASTM A536, Ductile Iron Castings.
- .12 ASTM A585, Specification for Aluminum-Coated Steel Barbed Wire.
- .13 ASTM A563, Carbon and Alloy Steel Nuts.
- .14 ASTM A615M, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- .15 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galv-annealed) by the Hot-Dip Process
- .16 ASTM A716, Specification for Ductile -Iron Culvert Pipe.
- .17 ASTM A746, Specification for Ductile -Iron Gravity Sewer Pipe.
- .18 ASTM A760, Corrugated Steel Pipe, Metallic-coated for Sewers and Drain.
- .19 ASTM A 775/A 175M, Specification for Epoxy-Coated Reinforcing Steel Bars.

.7 ASTM (B)

- .1 ASTM B62, Specification for Composition Bronze or Ounce Metal

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- Castings.
- .2 ASTM B88M, Specification for Seamless Copper Water Tube.
 - .3 ASTM B221M, Specifications for Aluminium and Aluminium-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
 - .4 ASTM B633, Electro-deposited Coatings of Zinc on Iron and Steel.
 - .5 ASTM B766, Electro-deposited Coatings of Cadmium.
- .8 ASTM (C)
- .1 ASTM C14M, Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
 - .2 ASTM C76M, Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - .3 ASTM C88, Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
 - .4 ASTM C109, Test Method for Compressive Strength of Hydraulic Cement Mortars {Using 2 inches of 50 mm Cube Specimens}.
 - .5 ASTM C117, Test Method for Material Finer than 0.075 mm Sieve in Mineral Aggregate .
 - .6 ASTM C123, Test Method for Lightweight Pieces in Aggregate
 - .7 ASTM C127, Test Method for Specific Gravity and Absorption of Coarse Aggregate.
 - .8 ASTM C-128, Test Method for Specific Gravity and Absorption of Fine Aggregate .
 - .9 ASTM C131, Test Method for Resistance to Degradation of Small Size Course Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .10 ASTM C136, Method for Sieve Analysis of Fine and Coarse Aggregates .
 - .11 ASTM C139, Specification for Concrete Masonry Units for Construction of Catchbasins and Manholes.
 - .12 ASTM C 171, Specification for Sheet Materials for Curing

-
- Concrete.
- .13 ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .14 ASTM C332, Specification for Lightweight Aggregates for Insulating Concrete.
 - .15 ASTM C443M, Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - .16 ASTM C478M, Specification for Precast Reinforced Concrete Manhole Sections.
 - .17 ASTM C497, Test Method for Concrete Pipe, Manhole Sections or Tile
 - .18 ASTM C506M, Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe.
 - .19 ASTM 507M, Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe.
 - .20 ASTM C827, Test Method for Early Volume Change of Cementitious Mixtures.
 - .21 ASTM C902, Specification for Pedestrian and Light Traffic Paving Brick.
 - .22 ASTM C939, Test Method for Flow of Grout for Prep/aced-Aggregate Concrete.
 - .23 ASTM C1433, Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers.
 - .24 ASTM C1103, Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
- .9 ASTM (D)
- .1 ASTM D36, Test Method for Softening Point of Bitumen (Ring & Ball Apparatus).
 - .2 ASTM D 140, Method for Sampling Bituminous Materials.
 - .3 ASTM D142, Test Method for Rubber Properties in Tension.
 - .4 ASTM D570, Test Method for Water Absorption of Plastics.
 - .5 ASTM D624-86, Test Method for Rubber Property- Tear

Resistance.

- .6 ASTM D624-86, Test Method for Rubber Property -Tear Resistance.
- .7 ASTM D698, Test methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 2.49 kg Rammer and 304.8 mm Drop.
- .8 ASTM D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Material.
- .9 ASTM D995, Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
- .10 ASTM D1190, Concrete Joint Sealer, Hot-Applied Elastic Type.
- .11 ASTM D1248, Specification for Polyethylene Plastics Molding and Extrusion Materials .
- .12 ASTM D 1557, Specification for Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10 lb (4.54 kg) Rammer and 18 inch (457 mm) Drop.
- .13 ASTM D1559, Test Method Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.
- .14 ASTM D1751, Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- .15 ASTM D1752, Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .16 ASTM D1784, Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.
- .17 ASTM D 1862, Test Methods for Breaking Load and Elongation Textile Fabric.
- .18 ASTM D2000, Classification System for Rubber Products in Automotive Applications.
- .19 ASTM D2152, Test Method for Quality of Extruded Polyvinyl Chloride (PVC) Pipe by Acetone Immersion.
- .20 ASTM D2241, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR).
- .21 ASTM D2310, Classification for Machine Made Reinforced Thermosetting Resin Pipe.
- .22 ASTM D2321-05, Standard Practice for Underground Installation of

- Thermoplastic Pipe for Sewers and Other Gravity-flow Applications.
- .23 ASTM D2412, Standard Test Method for External Loading Properties of Plastic Pipe by Parallel - Plate Loading.
- .24 ASTM D2419, Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- .25 ASTM D2657, Standard Practices for Heat Fusion Joining Polyethylene Pipe and Fittings.
- .26 ASTM D2680, Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
- .27 ASTM D2774, Practices for Underground, Installation of Thermoplastic Pressure Piping.
- .28 ASTM D2837, Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
- .29 ASTM D2990, Standard Test Method for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.
- .30 ASTM D2992, Method for Obtaining Hydrostatic Design Basis for Reinforced Thermosetting Resin Pipe and Fittings.
- .31 ASTM D2996, Specification for Filament Wound Reinforced Thermosetting Resin Pipe.
- .32 ASTM D3034, Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .33 ASTM D3035-08, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR). Based on controlled outside diameter.
- .34 ASTM D3139, Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
- .35 ASTM D3203, Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
- .36 ASTM D3210, Classification for Machine Made Reinforced Thermosetting Resin Pipe
- .37 ASTM D3212, Specifications for Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals.
- .38 ASTM D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing..
- .39 ASTM D3350, Specification for Polyethylene Plastic Pipe and Fittings Materials
- .40 ASTM D3405, Specification for Joint Sealants, Hot Poured for

Concrete and Asphalt Pavements.

- .41 ASTM D4101, Propylene Plastic Injection and Extrusion Materials.
 - .42 ASTM D4318, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - .43 ASTM D4354, Practice for Sampling of Geo-synthetics for Testing.
 - .44 ASTM D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
 - .45 ASTM D4956, Standard Specification for Retro-reflective Sheeting for Traffic Control.
 - .46 ASTM D5813, Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems.
- .10 ASTM (E)
- .1 ASTM E11, Specification for Wire Cloth Sieves for Testing Purposes.
 - .2 ASTM E1155M, Test Method for Determining Floor Flatness and Levelness Using the F-Number System.
 - .3 ASTM E1252, Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis.
- .11 ASTM (F)
- .1 ASTM F436, Hardened Steel Washers.
 - .2 ASTM F477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - .3 ASTM F593, Stainless Steel Bolts, Hex Cap Screws and Studs.
 - .4 ASTM F594, Stainless Steel Nuts.
 - .5 ASTM F679, Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
 - .6 ASTM F714, Polyethylene (PE) Plastic Pipe (SDR-DR) Based on Outside Diameter.
 - .7 ASTM F738, Stainless Steel Metric Bolts, Screws, and Studs.
 - .8 ASTM F794, Specification for Polyvinyl Chloride (PVC) Ribbed Gravity Sewer Pipe and Fittings based on Controlled Inside Diameter.
 - .9 ASTM F836M, Style 1 Stainless Steel Metric Nuts.

- .10 ASTM F1055, Standard Specification for Electro-fusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
- .11 ASTM F1216, Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
- .12 ASTM F1743, Standard Practice for the Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP).
- .13 ASTM F2019, Standard Practice for the Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP).
- .12 AWWA: (See ANSI /AWWA)
- .13 BCLNA BC Landscape Standard 2008 (7th Ed)
Canadian Standard for Nursery Stock – (8th Ed)
Canadian System of Soil Classification – (3rd Ed)
- .14 CAN3 = CAN/CSA
 - .1 CAN3-A 165 Series, CSA Standards on Concrete Masonry Units.
 - .2 CAN3-B137.3, Rigid Poly (Vinyl Chloride) (PVC) Pipe for Pressure Applications.
 - .3 CAN4-S543, Internal Lug, Quick-Connect Couplings for Fire Hose.
 - .4 CAN3-B70, Cast Iron Soil Pipe and Fittings, and Means of Joining.
 - .5 CAN3-G401, Corrugated Steel Pipe Products.
 - .6 CAN3-A23.3, Design of Concrete Structures for Buildings.
- .15 CAN/CSA = CAN3
 - .1 CSA A3000, Portland Cement; Masonry Cement, Blending Hydraulic Cement, Cementitious Hydraulic Slag.
 - .2 CAN/CSA-A5, Portland Cement.
 - .3 CAN/CSA-A8, Masonry Cement.
 - .4 CAN3-A23.1, Concrete Materials and Methods for Concrete Construction.
 - .5 CAN/CSA-A23.2, Methods of Testing for Concrete.

- .6 CAN/CSA-A23.5, Supplementary Cementing Materials.
- .7 CAN3-A231.2, Precast Concrete Pavers.
- .8 CAN3-A266. 1, Air-Entraining Admixtures for Concrete.
- .9 CAN3-A266.2, Chemical Admixtures for Concrete.
- .10 CAN3-A266.4, Guidelines for the use of Admixtures in Concrete.
- .11 CAN3-A362, Blending Hydraulic Cement.
- .12 CAN/CSA-A363, Cementitious Hydraulic Slag.
- .13 CAN/CSA-B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.
- .14 CAN/CSA-B182.6M, Profile of Polyolefin Sewer Pipe and Pipe Fittings.
- .15 CAN/CSA-G40.21, Structural Quality Steels.

- .16 CAN / CGSB
 - .1 CAN/CGSB-8.1, Sieves Testing, Woven Wire.
 - .2 CAN/CGSB-8.2, Sieves Testing, Woven Wire, Metric.
 - .3 CAN/CGSB-138. 1, Fence, Chain Link, Fabric
 - .4 CAN/CGSB-138.2, Fence, Chain Link, Framework, Zinc-Coated, Steel.
 - .5 CAN/CGSB-138.3, Fence Chain Link -Installation.
 - .6 CAN/CGSB-138.4, Fence, Chain Link, Gates.
 - .7 CAN/CGSB-37.2, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Damp-proofing and Waterproofing and for Roof Coatings.
 - .8 CAN/CGSB-16. 1, Asphalts, Liquids Petroleum, for Road Purposes
 - .9 CAN/CGSB-16.2, Asphalts, Emulsified, Anionic Type, for Road Purposes.
 - .10 CAN/CGSB-16.3, Asphalt Cements for Road Purposes.
 - .11 CAN/CGSB-16.5, Asphalt, Emulsified, High Float Type, for Road Purposes.

- .17 CGSB
 - .1 CGSB 1-GP-12c, Standard Paint Colours.
 - .2 CGSB 1-GP-59M, Enamel, Exterior Gloss Alkyd Type.
 - .3 CGSB 1-GP-5M, Thinner, Petroleum Spirits, Low Flash {R/84}.
 - .4 CGSB 1-GP-71, Method of Testing Paints and Pigments.

- .5 CGSB 1-GP-74M, Paint, Traffic, Alkyd.
- .6 CGSB 1-GP-149M, Paint, Traffic, Reflectorized Alkyd, White and Yellow.
- .7 CGSB 15.1-92, Standard for Calcium Chloride.
- .8 CGSB 1-GP-181M, Coating, Zinc-Rich, Organic, Ready Mixed.
- .9 CGSB 51-GP-51M, Polyethylene Sheet for Using in Building Construction.
- .10 CGSB 41-GP-25M, Pipe, Polyethylene, for the Transport of Liquids.
- .18 CSA
 - .1 CSA 283, Qualification Code for Concrete Testing Laboratories.
 - .2 CSA A14, Concrete Poles.
 - .3 CSA A82. 5, Structural Clay Non-Load-Bearing Tile.
 - .4 CSA A82. 56, Aggregate for Masonry Mortar.
 - .5 CSA A 123.3, Asphalt or Tar Roofing Sheets.
 - .6 CSA A257, Standards for Concrete Pipe and Manholes (AS257.0 through AS257.4).
 - .7 CSA B137.0, Definitions, General Requirements, and Methods of Testing for Thermoplastic Piping.
 - .8 CSA B137.1, Polyethylene Pipe, Tubing and Fittings for Cold Water Pressure Services.
 - .9 CSA B137.2, PVC Injection Moulded Gasketed Fittings for pressure Applications.
 - .10 CSA B137.3, Rigid Poly (Vinyl Chloride) (PVC) Pipe for Pressure Applications.
 - .11 CSA B137.6, CPVC Pipe, Tubing and Fittings for Hot and Cold Water Distribution Systems.
 - .12 CSA B137.7, Polybutylene (PB) Pipe for Cold Water Distribution systems.
 - .13 CSA B137.8, Polybutylene (PB) Pipe for Pressure Applications.
 - .14 CSA B137.9(M91), Polyethylene, Aluminium, Polyethylene Composite Pressure Pipe.
 - .15 CSA B137.16, Recommended Practice for the Installation of CPVC Piping for Hot and Cold Water Distribution Systems.
 - .16 CSA 182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.

- .17 CSA B 182.11, Recommended Practice for the Installation of Plastic Drain and Sewer Pipe and pipe Fittings
- .18 CSA B181.12, Recommended Practice for the Installation of PVC Drain, Waste, and Vent Pipe Fittings.
- .19 CSA B 182.11, Recommended Practice for the Installation of Plastic Drain and Sewer Pipe and pipe Fittings.
- .20 CSA B182.2, Large Diameter, Type PSM PVC Sewer Pipe and Fittings.
- .21 CSA B182.4, Large Diameter Ribbed PVC Sewer Pipe and Fittings.
- .22 CSA C22.1, Safety Standard for Electrical Installations.
- .23 CSA C22.2, Canadian Electrical Code, General Requirements.
 - No. 03 Test Methods for Electrical Wires and Cables
 - No. 18.1 Metallic Outlet Boxes
 - No. 18.4 Hardware for the Support of Conduit, Tubing and Cable
 - No. 29 Panelboards and Enclosed Panelboards
 - No. 38 Thermoset Insulated Wires and Cables
 - No. 42 General Use Receptacles, Attachment Plus and Similar Wiring Devices Rigid
 - No. 45 Metal Conduit
 - No. 49 Flexible Cord and Cables
 - No. 56 Flexible Metal conduit and Liquid Tight Flexible Metal Conduit
 - No. 85 Rigid PVC Boxes and Fittings
 - No. 89 Splitters
- .24 CSA C22.3, Canadian Electrical Code Outside Wiring.
- .25 CSA G30.3, Cold Drawn Steel Wire for Concrete Reinforcement.
- .26 CSA G30.5, Welded Steel Wire Fabric for Concrete Reinforcement.
- .27 CSA 30.12 - M77, Billet-Steel Bars for Concrete Reinforcement.
- .28 CSA G30. 14, Deformed Steel Wire for Concrete Reinforcement.
- .29 CSA G30. 15, Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
- .30 CSA G30.16, Weldable Low Alloy Steel Deformed Bars for Concrete Reinforcement.
- .31 CSA G 164, Hot Dip Galvanizing of Irregularly Shaped Articles.
- .32 CSA S 157, Strength Design in Aluminum.

- .33 CSA S269.3, Formwork
- .34 CSA W59, Welded Steel Construction (Metal Arc Welding).
- .35 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .36 CSA G40.20, General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steels.
- .19 C-SHRP
 - 1. Superpave Series No.2 (SP-2) Superpave level 1 Mix Design
 - 2. Technical Brief #17, Superpave 2000 -Improved Standards for a new Millennium.
- .20 IMSA
 - 1. 50-2, Polyethylene insulated, polyethylene jacketed, loop detector lead-in cable.
- .21 NEMA
 - 1. TS 2-2003(R2008), Traffic Controller Assemblies with NTCIP Requirements, Version 02.60.
 - 2. 250-2003, Enclosures for Electrical Equipment (1,000 Volts Max).
- .22 BCH
 - 1. BCH 1-9, Degradation Test
 - 2. BCH 1-13, Fracture Count on Coarse Aggregates
 - 3. Electrical and Signing Material Standards.
 - 4. Specifications for Standard Highway Sign Materials, Fabrication and Supply.
- .23 Plastic Pipe Institute Handbook on Polyethylene Pipe

END OF SECTION

1.0 GENERAL

- .1 Section 02100 addresses general requirements for measurement and payment for all items under the Schedule of quantities and Prices.
- .2 If a separate item is not provided for in the Schedule of Quantities and Prices but is indicated in the specifications or on the drawings as being part of the work, e.g. reinstatement, then provide for it in the rates generally.
- .3 If an “allowance” is provided for in the Schedule of Quantities and Prices, it shall take the same general meaning as Contingency Allowance as defined in the General Conditions of Contract.

1.1 Measurement and Payment

- .1 Units of measurement for payment will be as indicated in the Schedule of Quantities and Prices. Payments will be based on respective unit or lump sum prices in the Schedule of Quantities and Prices or in Change Orders if issued.
- .2 Unless specified otherwise, the standard methods of measurement will be as follows:
 - Linear measurement will be measured in place taken from end to end along the length of the measured item.
 - Area measurement will be calculated from conventionally accepted geometric area formulae using linear measurements taken in place of the completed area of work or, alternatively, by using GPS co-ordinates taken on site of the boundary of the area of the work completed and inputted into an acceptable software model such as Civil 3D, the method being agreed to prior to commencement of the work.
 - Cubic measurement will be made in place, all as specified under individual payment sub-sections, using one of the following methods:
 - 3 dimensional software modelling techniques (Civil 3D or equal) using data derived from field surveys completed before and after the work but only to the limits shown on the drawings or as agreed
 - end area method at 15m sections (unless agreed differently) using data derived from field surveys

- completed before and after the work but only to the limits shown on the drawings or as agreed
 - rocks or boulders greater than 0.5 m³ in volume, measured in the shortest direction in the x, y and z planes and by multiplying the three values together for each rock or boulder > 0.5 m³ in volume.
 - loose truck box volume by truck count, which volume shall be agreed in advance.
 - Weight measurement for materials delivered in truckloads will be made by weigh tickets displaying the truck weight before and after loading, to be verified in accordance with the Force Account procedure.
- .3 Unless otherwise specified, accuracy of measurement will be to the nearest significant decimal value as given below:

Asphalt	0.1 tonne
Concrete	0.01 cubic metre
Excavation, earth, and granular materials	0.1 tonne or cubic metre
Pipes	0.1 metre
All unit items	each
Clearing, grubbing, top soil, seeding, sodding area	1.0 metre squared (m ²)
Asphalt or concrete area	Length to 0.1 metre by specified Width to 0.1 metre
Lump sum for provide, maintain	To be specified

- 1.2 Payment Inclusions**
- .1 Payment for items under Schedule of Quantities and Prices includes the supply and installation of work described under the items and referenced in the Measurement and Payment clauses in the Supplemental General Conditions, including all necessary materials, equipment and labour, cut and waste, working clearance, specified testing for the finished items of work, other incidental and miscellaneous materials, fitting, appurtenances and work and requirements under Division I and as specified under respective Sections of Master Municipal Specifications and under Instructions to Tenderers, paragraph 10.1.
- .2 Unless provided for otherwise, the costs of bonds, insurance, Workers Compensation contribution,

superintendence, overheads, profits, and other incidentals, where not identified separately, are deemed to have been included in the pay items of the Schedule of Quantities and Prices generally.

- .3 Payment will not be made for unauthorized work nor work beyond limits shown on Contract Drawings.

1.3 Description of Pay Items

- .1 The completion of individual items of work under the Contract shall be measured and paid for in accordance with the Description of Pay Items in Section 5 of the Supplemental General Conditions of Contract.

1.4 Partially Completed Work at the End of Pay Periods

- .1 Lump Sum or unit rate items which are only partially completed at the end of pay periods will be paid for as a percentage of the value of the work completed, in the case of Lump Sum items or pro-rated according to the state of the work, e.g. watermain installed and backfilled but not yet tested or disinfected, as approved by the Contract Administrator.

*** END SECTION 02100 ***

- .1 Prevent damage to all adjacent natural growth, landscaping, buildings, structures, and underground and overhead utilities. Make good all damage to satisfaction of Contract Administrator.
- .2 Apply specified tree paint to cuts or scars suffered by vegetation designated to remain.

**1.4 Measurement
and Payment**

- .1 Refer to Section 02100, Measurement and Payment.

**1.5 Inspection and
Testing**

- .1 Refer to General Conditions, Clause 4.12, Inspections.

2.0 PRODUCTS NOT APPLICABLE

3.0 EXECUTION

- .1 Prior to clearing, verify limits of clearing with Contract Administrator, and determine any restriction regarding preservation of existing trees, shrubs, natural features, or improvements within or adjacent to specified limits of clearing.
- .2 The Contractor shall be responsible for timber permits.

3.1 Clearing

- .1 Clear trees, shrubs, uprooted stumps, and surface debris not designated to remain.
- .2 Cut off trees, brush, and scrub at a height of not more than 300mm above ground. In areas to be subsequently grubbed, ensure height of stumps left from clearing operations not more than 1000mm above existing ground.
- .3 Upon written authorization from Contract Administrator, cut off unsound branches of trees designated to be preserved and fall isolated trees overhanging area to be cleared.
- .4 Preserve all shrubs, trees, or other cultivated plants specified for replanting.

**3.2 Close-Cut
Clearing**

- .1 Cut off trees, shrubs, stumps, and other vegetation at ground level.

3.3 Isolated Trees

- .1 Cut off isolated trees as shown on Contract Drawings or as directed by Contract Administrator at height of not more than 300mm above existing ground.
- .2 Grub out isolated tree stumps.

3.4 Grubbing

- .1 Grub out stumps and roots in cleared areas to not less than 200mm below existing ground surface.

3.5 Removal and Disposal

- .1 Unless specified otherwise in Supplementary Specifications all timber becomes property of Contractor.
- .2 Off-site disposal of cleared and grubbed materials will not be required.
- .3 Cleared and grubbed waste materials are intended to be disposed of on-site via burning of slash piles. The Contractor is responsible for burning of rubbish, fire control, and burning permits.
- .4 Where specified, chip or mulch and spread cleared and grubbed vegetative material on site.

3.6 Finished Surface

- .1 Leave ground surface in condition suitable for immediate grading operations or stripping of topsoil if so specified.

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1.0 General

- .1 Section 02211 refers to those portions of the work for preparation of subgrade by grading and filling, to provide a base that will allow placing of growing medium (topsoil) to specified depths. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 This section is based on the “British Columbia Landscape Standard” published by the B.C. Society of Landscape Architects and the B.C. Nursery Trades Association. This standard is intended to set a level of quality which is to be equalled or bettered in the construction documents for each project. Guidance of a registered British Columbia Landscape Architect is recommended.
- .3 This section is included for reinstatement work.

1.1 Related Work

- .1 Topsoil and Finish Grading Section 02921
- .2 Seeding Section 02933
- .3 Hydraulic Seeding Section 02934
- .4 Sodding Section 02938
- .5 Planting of Trees, Shrubs
and Ground Covers Section 02950

1.2 References

- .1 British Columbia Landscape Standard.
- .2 Canadian System of soil classification

1.3 Site Conditions

- .1 Examine site with Contract Administrator and obtain approval of previous work prior to commencing site grading.
- .2 Comply with General Conditions, Clause 4.3, Protections of Work, Property and the Public, and Clause 4.5, Errors, Inconsistencies or Omissions in the Contract Documents.

**1.4 Measurement
and Payment**

- .1 If a separate Landscape Grading Item is not included in the schedule of rates e.g. reinstatement, then it shall be provided for in the rates generally.

- .2 Refer to Section 02100, Measurement and Payment, Subsection 1.2, Description of Pay Items.

1.5 Inspection and Testing

- .1 Refer to General Conditions, Clause 4.12, Inspections.

2.0 PRODUCTS

2.1 Materials

- .1 Fill Materials: In case of deficit of in-place or specified materials, all additional materials necessary to bring site up to specified grade to comply with material specified in appropriate Section or shown on Contract Drawings.
- .2 Obtain approval from Contract Administrator for excavated or graded material to be used as fill for grading work. Protect approved material from contamination.
- .3 Fill material to be placed under areas to be landscaped, i.e., with grass, sod, groundcover, shrubs and trees, to be non-toxic to plant and animal life in part or in concentration (leachate).

3.0 EXECUTION

3.1 Stripping of Topsoil

- .1 Strip all organic material to specified limits and specified limits and specified depth. Stockpile for re-use on site during construction. Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected. Remove all debris and unusable material as specified in the Contract Documents. Prior to construction completion, the stockpiled topsoil materials shall be spread on-site in such a fashion as to achieve a reasonable landscaped finish to the site.
- .2 Surface drainage: Provide suitable temporary ditches or other approved means of handling drainage prior to excavation and during construction to protect construction area and adjacent and other adjacent

properties. Provide siltation controls to protect natural watercourses or existing drainage facilities.

3.2 Grading

- .1 Rough grade to levels, profiles, and contours allowing for surface treatment as shown on Contract Drawings.
- .2 Compact subgrade to a consistent 80% Modified Proctor Density in compliance with ASTM D1557.
- .3 Excavate soft and instable areas below subgrade that cannot be compacted to this standard and fill with approved fill material, except in locations where special environmental conditions have been identified. In such cases, comply with Supplementary Specifications and details shown on Contract Drawings.
- .4 Remove and dispose to approved ~~off-site~~ disposal areas, all debris, roots, branches, stones, building material, contaminated subsoil, visible weeds and anything else that may interfere with proper growth and development of planned finished landscaping.
5. Place fill materials to elevations and sections shown on Contract Drawings. Place in maximum 200mm lifts and compact each lift to 80% Modified Proctor Density immediately before placing growing medium (topsoil).
- .6 Scarify areas showing excessive compaction to minimum depth of 150mm and compact to 80% Modified Proctor Density immediately before placing growing medium (topsoil).
- .7 Ensure gradients within ranges shown in Table 1, except where Contract Drawings show variation from this standard.
- .8 Grade transitions of subgrade smooth and even, such that ponding cannot occur on subgrade surface.

TABLE 1: Maximum and Minimum Gradients in Landscaped Areas

Location	Minimum	Maximum
Lawn and Grass	50:1 (2%)	3:01
Grass Swales (without additional erosion protection)	50:1 (2%) 6:1	10:1 (10%)
i) Slope along inverts	(preferred)	3:01
ii) Slide Slopes		
Unmowed Areas	100:1 (1%)	2:1*
Planted Areas	50:1 (2%)	2:1*

*Unless directed otherwise by Contract Administrator

3.3 Tolerances

- .1 Accuracy of subgrade elevations to be within tolerances shown in Table 2.

TABLE 2: Tolerances for Subgrades Where Growing Medium (Topsoil) to be Placed Over Subgrade

Conditions	Intended Growing Medium Depth	Tolerance
Within 3 m from fixed elevations (e.g. paving edges, curbs, etc.)	0-15 mm	(+/-) 25mm
	151-300 mm	(+/-) 25 mm
	301 - 600 mm	(+/-) 50 mm
Other areas	0-150 mm	(+/-) 25 mm
	151-300 mm	(+/-) 50 mm
	301-600 mm	(+/-) 50 mm)

- 3.4 Surplus Material** .1 Remove surplus material unsuitable for fill, grading, or landscaping and dispose at approved disposal area.
- 3.5 Topsoil and Finish Grading** .1 See Section 02921 – Topsoil and Finish Grading for placement and finish grading of growing medium (topsoil).

1.0 General

- .1 Section 02223 refers to those portions of the work that are unique to excavating, trenching, and backfilling of underground utility installations and related to structures. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein. This section shall also refer to installation of pipe and conduit installed for telecommunications, gas, and electrical services.

1.1 Related Work

- | | | |
|-----|-----------------------------------|---------------|
| .1 | Environmental Protection | Section 01561 |
| .2 | Rock Removal | Section 02221 |
| .3 | Controlled Density Fill | Section 02236 |
| .4 | Aggregates and Granular Materials | Section 02950 |
| .5 | Waterworks | Section 02666 |
| .6 | Storm Sewers | Section 02721 |
| .7 | Pipe Culverts | Section 02723 |
| .8 | Manholes and Catchbasins | Section 02725 |
| .9 | Sanitary Sewers | Section 02731 |
| .10 | Sewage Forcemains | Section 02732 |
| .11 | Topsoil and Finish Grading | Section 02921 |
| .12 | Packaged Equipment | Section 15000 |

1.2 References

- .1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in References – Section 02000.

1.3 Definitions

- .1 Rock Excavation: as defined in Section 02221 – Rock Removal.
- .2 Common Excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation including dense tills, hardpan, partially cemented materials, clay or frozen materials

which can be ripped and excavated with heavy construction equipment.

- .3 Over-excavation: excavation below design elevation of bottom of specified bedding, and including backfilling of resultant excavation with specified material, as authorized by Contract Administrator.
- .4 Removals: removal and disposal at an approved location off-site of surface concrete structures and walks, curbs, gutters, manholes, catchbasins, pipes, culverts, endwalls, and any other structures on surface or underground specifically designated on Contract Drawings for removal. Removals to include backfilling of resultant excavation with specified material.
- .5 Native Topsoil: to Section 02921 – Topsoil and Finish Grading.

**1.4 Protection of Work,
Property, and
Public**

- .1 Comply with General Conditions, Clause 4.3, Protection of Work, Property, and the Public.

**1.5 Safety
Requirements**

- .1 Comply with General Conditions, Clause 4.2, Safety.
- .2 Design and install trench shoring in accordance with the regulations of the Workers Compensation Act of British Columbia.

1.6 Blasting

- .1 Ensure all blasting operations comply with Section 02221 – Rock Removal

1.7 Disposal

- .1 Dispose of all surplus spoil from excavation on-site and/or off-site as shown on Contract Drawings or as specified in Contract Documents. Suitability of excavated material for use as native bedding or trench backfill will be governed by Part 2 of this Section. Dumping of spoil on private property will be permitted only upon written approval from property owner and provided all necessary permits and approvals have been obtained.

**1.8 Limitations of
Open Trench**

- .1 Excavate trenches only as far in advance of pipe laying operation as safety, traffic, and weather conditions permit and, in no case, to exceed 30m. Before stopping work on last day of work before each weekend or holiday, completely backfill every trench. If circumstances do not permit complete backfilling of all trenches, adequately protect all open trenches or excavation with approved fencing or barricades and, where required, with flashing lights.

**1.9 Permits and
Approvals**

- .1 Comply with General Conditions, Clause 20, Laws, Notices, Permits, and Fees.

**1.10 Measurement and
Payment**

- .1 Refer to Section 02100, Measurement and Payment, Subsection 1.2, Description of Pay Items.

**1.11 Inspection and
Testing**

- .1 Refer to General Conditions, Clause 4.12, Inspections.

2.0 PRODUCTS

2.1 General

- .1 Unless shown otherwise on Contract Drawings the materials specified in 2.2 following are approved for their respective uses.

**2.2 Use of Specified
Material**

- .1 Backfill for over-excavated trench or structure excavations to be one of the following:
 - .1 Granular pipe bedding and surround material.
 - .2 Pit run sand.
 - .3 Drain rock (only where approved by Contract Administrator).
 - .4 Concrete.
 - .5 Controlled density fill.
- .2 Pipe bedding and surround: see applicable Sections:
 - .1 Waterworks Section 02666
 - .2 Storm Sewers Section 02721
 - .3 Pipe Culverts Section 02723

- | | | |
|----|--------------------|---------------|
| .4 | Sanitary Sewers | Section 02731 |
| .5 | Sewage Force mains | Section 02732 |
| .6 | Electrical | Section 16550 |

- .3 Trench and excavation backfill to be one of the following:
 - .1 Approved native material.
 - .2 Pit run gravel.
 - .3 Pit run sand.
 - .4 Controlled density fill.
- .4 Surface treatment to be:
 - .1 Restoration to match existing conditions.
 - .2 Subgrade, subbase, and base for works describe in other Sections.
 - .3 Topsoil, grass, sod, or requirements for landscaping works described in other Sections.

2.3 Materials

- .1 Refer to Section 02226 – Aggregates and Granular Materials for specifications for approved granular materials and approved native material.
- .2 Other granular materials: granular materials approved for roadwork (subbase, base) also acceptable for trench backfill subject to approval of Contract Administrator.
- .3 Concrete: to Section 03300, to be minimum 20MPa.
- .4 Controlled Density Fill: to Section 02236, to be maximum 0.5MPa.

3.0 EXECUTION

3.1 Site Preparation

- .1 Remove all brush, weeds, grasses, and accumulated debris to an approved offsite location.
- .2 Cut pavement or sidewalk neatly along limits of proposed excavation as shown on Standard Detail Drawing G4 in order that surface may break evenly and cleanly. Cut beyond limits shown only if authorized by Contract Administrator.

- .3 Where trench passes through lawn, neatly cut and remove sod before trench excavation. Save sod for replacement upon backfilling trench.
- .4 Strip topsoil after area has been cleared and stockpile in locations as shown on Contract Drawings. Stockpile height not to exceed 2m. Avoid mixing topsoil with subsoil. Dispose of unused topsoil as specified. Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.

3.2 Stockpiling

- .1 Stockpile fill materials in areas designated by Contract Administrator. Stockpile granular materials in manner to prevent segregation.

3.3 Excavation

- .1 Connection to existing mains:
 - .1 Prior to or at commencement of construction, check existing main for line and elevation at point of connection. If found different from Contract Drawings report such difference to Contract Administrator immediately. Comply with General Conditions, Clause 4.5, Errors, Inconsistencies or Omissions in the Contract Documents.
 - .2 Connections to existing waterworks systems to be made by Municipal crews unless shown otherwise on Contract Drawings. Make all necessary arrangements with Contract Administrator to schedule work to prevent construction delays.
 - .3 Connections to existing sanitary and storm sewer systems to be made by Contractor unless shown otherwise on Contract Drawings. Notify Contract Administrator minimum 48hrs in advance of scheduled connection. Make connection in presence of Contract Administrator.
 - .4 To prevent damage to existing utilities, excavate last 300mm over utility by hand.
- .2 Surface drainage:
 - .1 Provide suitable temporary ditches or other approved means of handling drainage prior to excavation and during construction to protect construction area and adjacent and other affected properties. Provide siltation controls to protect

- natural watercourses or existing municipal drainage facilities.
- .2 Comply with Section 01561 – Environmental Protection.
 - .3 Excavation to grade: excavate trenches to allow pipe to be laid to alignment and grades required with allowance for specified pipe bedding.
 - .4 Excavation below grade: when bottom of excavated trench at subgrade is unstable and in opinion of Contract Administrator, cannot adequately support pipe, install pipe using concrete bedding as shown on Contract Drawings or over-excavate trench to suitable subgrade or as directed by Contract Administrator. Backfill overexcavation with specified materials and compact to minimum 95% Modified Proctor density in compliance with ASTM D1557. Use drain rock backfill only if authorized by Contract Administrator.
 - .5 Trench width: excavate trench to section and dimensions shown on Standard Detail Drawing G4. If width exceeds maximum allowable, Contractor may be required to demonstrate that specified pipe is still adequate or provide pipe with approved higher strength class or provide approved higher class of bedding. All additional requirements as a result of excessive trench width to be to Contractor's cost.
 - .6 Hand excavation: excavate by hand if necessary to preserve or minimize damage to existing trees, shrubs, buildings, and all similar existing features or facilities.
 - .7 Trench bottom conditions: remove disturbed or softened material from trench bottom before placing bedding material. Maintain trench free from water and soft materials during placement of pipe bedding, pipe installation, and trench backfill to ensure proper compaction of granular materials.
 - .8 Trench drainage:
 - .1 During pipe laying, jointing, bedding, and backfilling, keep trench free of water by pumping or other appropriate means. Provide pumps and

dewatering equipment and take precautions to prevent any damage to adjoining buildings, structures, roads or land from prolonged or excessive pumping by installing shoring, sheeting or other supportive measures. Discharge water from excavation in such a manner as not to cause nuisance, injury, loss, or damage. Contractor to be responsible for any claims or actions arising from such discharge of water.

- .2 Keep bell holes free from water during jointing. Diverting trench water through newly laid system not allowed, unless authorized by Contract Administrator.
- .9 Disposal of surplus soil: dispose of surplus excavated soil off-site. Side-casting not allowed in restricted areas where, in opinion of Contract Administrator, side-casting would create interference with flow of traffic. In such case, temporarily store materials or dispose to an approved site. Provisions of Provincial Contaminated Sites Legislation must be met prior to disposal of soil offsite.
- .10 Where native backfill is approved for re-use, and side-casting not allowed, transport approved material to other locations where material is required or temporarily store at approved site. Protect stored material from contamination, segregation, and weather.
- .11 Rock excavation: to Section 02221 – Rock Excavation.
- .12 Maintain roads used for transporting materials and equipment in clean condition. Clean, flush and/or sweep on daily basis and more frequently if directed by Contract Administrator.

3.4 Pipe Installation

- .1 Related work: Pipe installation, including bedding, pipe laying, and granular surround to be in accordance with following sections:
 - .1 Waterworks Section 02666
 - .2 Storm Sewers Section 02721
 - .3 Pipe Culverts Section 02723
 - .4 Manholes and Catchbasins Section 02725
 - .5 Sanitary Sewers Section 02731

.6 Sewage Forcemains Section 02732

- .2 Concrete encasement or protection: where specified or required by Contract Administrator provide concrete encasement of pipe or slab protection as shown on Standard Detail Drawings G6 and G7. Do not place backfill material until concrete has taken its initial set and in no case less than 1hr.
- .3 Anchor blacks: where specified or required by Contract Administrator provide anchor blacks as shown on Standard Detail Drawing G8. Ensure all concrete anchor blocks at least 150mm into undisturbed ground on bottom and sides of trench. Concrete strength as specified on Standard Detail Drawing G8.

**3.5 Backfill and
Compaction**

- .1 General: place backfill carefully in trench to prevent damage to installed pipe.
- .2 Shoring: during backfill and compaction of trench, remove shoring in such a manner as to allow proper compaction and to prevent trench walls from collapsing. Remove all bracing and/or shoring from trench.
- .3 Backfill Materials:
 - .1 Boulevards and easements: for trenches in boulevards, easements or other areas not subjected to vehicle loading, and outside of ditchlines, backfill with approved native material except as shown otherwise on Contract Drawings.
 - .2 Roads, driveways, and shoulders: for trenches in paved or gravelled roads, driveways, shoulders, or other areas subjected to vehicle loading, backfill with imported granular material or approved native material as specified on Contract Drawings. Road shoulder is that portion of right-of-way between travelled portion of road, either paved or gravelled, and road ditch. Where no ditch exists, ensure shoulder width minimum of 1.5m.
 - .3 Ditches: backfill with imported granular material or approved native material as specified on Contract Drawings.

- .4 Contract Administrator may permit native material for all above uses subject to suitability of native material for said use. Native material approved for re-use to be handled, stockpiled, and compacted using construction method appropriate for given moisture content and weather conditions.
- .5 Controlled Density Fill: place controlled density fill in Accordance with Section 02236 – Controlled Density Fill.
- .4 Compaction: place backfill and compact to following Modified Proctor densities in compliance with ASTM D1557. (All following references to density imply compliance with ASTM D1557).
 - .1 Boulevards and easements to minimum 90%.
 - .2 Roads, driveways, shoulders, re-shaped ditches, and sidewalks to minimum 95%.
 - .3 Use caution in pipe zone to ensure no damage to pipe.

3.6 Surface Restoration .1 General:

- .1 Restore all disturbed surfaces to condition at least equal to that which existed prior to construction.
- .2 Make good any damage to adjacent lands or improvements.
- .3 Resolve all reasonable claims arising from Contractor's actions and obtain written releases from landowners following final restoration.
- .2 Boulevards and easements:
 - .1 Restore surface to minimum 100mm depth.
 - .2 Restore unimproved surfaces with material equal to that removed at surface.
 - .3 Restore gardens with approved topsoil or bark mulch to match existing conditions.
 - .4 Restore lawns with approved topsoil and seed or sod to match existing lawn.
 - .5 Restore gravel surfaces with matching granular materials.
 - .6 Complete final restoration immediately upon completion of trench backfilling.
- .3 Gravelled roads and driveways:

- .1 Restore surface with minimum 75mm to 100mm thick lift of 19mm granular road base material.
- .2 Compact to minimum 95% Modified Proctor density.
- .3 Complete final restoration immediately upon completion of trench backfilling.
- .4 Ditches:
 - .1 Re-shape ditches to specified lines, grades and sections and restore surface with minimum 300mm of specified material to ensure stability of ditch slopes and bottom.
 - .2 Compact to minimum 95% Modified Proctor density.
 - .3 Complete final restoration immediately upon completion of trench backfilling.
- .5 Base preparation for paved surfaces:
 - .1 Paved surfaces to include all paved roads, driveways, sidewalks, and parking areas.
 - .2 If native material used for backfill provide specified depth of subbase as shown on Contract Drawings.
- .6 Temporary pavement and patching:
 - .1 Patch arterial and collector roads same day excavation made.
 - .2 Patch all other roads within 24hrs of closing trench.
 - .3 Patching material to be hot-mix asphalt on all roads only where directed by Contract Administrator.
 - .4 Place temporary pavement to 50mm minimum thickness.
 - .5 Maintain temporary patch to ensure safe and smooth conditions.
- .7 Permanent pavement restoration:
 - .1 Install permanent pavement within 30 days of placement of temporary patch or sooner where directed by Contract Administrator. Permanent pavement to be installed to specifications of the Ministry of Transportation or as indicated on Contract Drawings.
 - .2 Remove broken or cracked pavement as well as any paved areas showing settlement and dispose off-site.

-
- .3 Remove underlying granular road base material as required to permit placement of specified thickness of permanent pavement. Ensure remaining base meets specified thickness. Material and placement of road base to Granular Base – Section 02233.
 - .4 Compact base to minimum 95% Modified Proctor density.
 - .5 Restore pavement as detailed on Standard Detail Drawing G5. If thickness of existing pavement permits, grind 35mm depth along edge of pavement. Dry if necessary and paint clean, dry edge with asphalt emulsion (tack coat).
 - .6 Place and compact hot-mix pavement material to minimum thickness as shown on Standard Detail Drawing G5.
 - .7 Material and placement of hot-mix pavement to Hot-Mix Asphalt Concrete Paving – Section 02512.
 - .8 Restore surface to smooth condition and match with grade of adjacent pavement.
 - .9 Where shown on Contract Drawings place hot-mix overlay over restored trench section and adjacent pavement to Hot-Mix Asphalt Concrete Paving – Section 02512.
 - .10 Maintain restored pavements in complete repair during Maintenance Period. Effect repairs within 14 days from receipt of written notice from Contract Administrator or immediately if so directed by Contract Administrator if dangerous situation exists.
- .8 Landscape Restoration:
- .1 Landscape restoration to following sections:
 - .1 Topsoil and Finish Grading Section 02921
 - .2 Seeding Section 02933
 - .3 Hydraulic Seeding Section 02934
 - .4 Sodding Section 02938
 - .5 Planting of Trees, Shrubs,
And Ground Covers Section 02950
 - .2 Restoration of planted areas, either in private or public places, to consist of restoration to original condition by replacement to original depth of approved topsoil (minimum 100mm), seeding or Sodding of grassed areas and replacement of any killed or removed plants or shrubs by ones of equal quality, type, and maturity to originals. Should

- restored item fail to grow successfully either throughout work area, or in patches, restore so that a successful regrowth is established over entire area.
- .3 Plant replacement trees and shrubs at a suitable time of year in accordance with good horticultural practice, to provide maximum assurance of plant survival. If tree or shrub has died, or shows signs of dying, as a result of environmental disturbance, cutting of roots, or other cause directly attributable to Contractor's work, close to but not actually within excavated area, replace with new tree or shrub of a similar variety, age, and size up to limits of maximum available size.
- .9 Restoration acceptance: no restoration work to be considered satisfactory until acceptance by Contract Administrator and in case of properties not owned by Municipality, until a written and signed statement of release from property owner has been obtained by Contractor and provided to Contract Administrator.

- .5 Embankment (subgrade fill): material derived from usable excavation and placed above original ground or stripped surface up to subgrade elevation.
- .6 Imported embankment fill: approved granular material, supplied by Contractor and obtained from off site sources, to be used for embankment fill up to subgrade elevation.
- .7 Pavement structure: combination of layers unbound or stabilized granular sub base, base, and asphalt or concrete surfacing.
- .8 Subgrade elevation: elevation immediately below pavement structure.

**1.4 Protection of Work
Property and Public**

- .1 Comply with General Conditions, Clause 4.3, Protection of Work, Property, and Public

1.5 Blasting

- .1 All blasting operations to comply with Section 02221 – Rock Removal.

1.6 Disposal

- .1 Refer to Section 02223 – Excavating, Trenching, and Backfilling, Clause 1.7, Disposal, for re-use and off-site disposal requirements.

**1.7 Permits and
Approvals**

- .1 Comply with General Conditions, Clause 20, Laws, Notices, Permits and Fees before commencing any excavation.

**1.8 Measurement and
Payment**

- .1 Refer to Section 02100, Measurement and Payment, Subsection 1.2, Description of Pay Items.

**1.9 Inspection
and Testing**

- .1 Refer to General Conditions, Clause 4.12, Inspections.

2.0 PRODUCTS

2.1 General

- .1 Unless shown otherwise on Standard Detail Drawings or, where applicable, Contract Drawings materials specified in 2.2 following are approved for their respective uses.

2.2 Specified Materials

- .1 Backfill for embankment fill (subgrade fill) to be:
 - .1 Approved native or imported granular material.
 - .2 Pit run gravel.
 - .3 Pit run sand.

2.3 Materials

- .1 Refer to General Conditions, Clause 4.12, Inspections.
- .2 Refer to Section 02226 – Aggregates and Granular Materials for specifications for approved granular materials.

3.0 EXECUTION

3.1 General

- .1 Clear and grub limits of excavation and/or embankment fill in accordance with Section 02111 – Clearing and Grubbing.
- .2 Strip all organic material to specified limits and specified depth or as directed by Contract Administrator. Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected. Remove all debris. Stockpile and place topsoil as specified.
- .3 Surface drainage:
 - .1 Provide suitable temporary ditches or other approved means of handling drainage prior to excavation and during construction to protect construction area and adjacent and other affected properties. Provide siltation controls to protect natural watercourses or existing municipal drainage facilities.
 - .2 Comply with Section 01561 – Environmental Protection.

3.2 Excavation

- .1 Notify Contract Administrator sufficiently in advance of excavation operations for initial cross-sections to be taken.

- .2 Notify Contract Administrator whenever unsuitable materials are encountered in cut sections and remove unsuitable materials to depth and extent as directed by Contract Administrator.
- .3 If, during excavation, material appearing to conform to classification for rock is encountered, notify Contract Administrator in sufficient time to enable measurements to be made to determine volume of rock.
- .4 Rock excavation: rock excavation to Section 02221 – Rock Excavation.

3.3 Inspection of Native Surface

- .1 Prior to placing embankment fill, proof roll graded native surface using fully loaded single or dual axle dump truck. Contract Administrator may authorize use of other acceptable proof rolling equipment. Remove soft or other unstable material. Replace with approved embankment fill and compact replacement fill to minimum 95% Modified Proctor density in compliance with ASTM D1557. (All following references to density imply compliance with ASTM D1557).

3.2 Placing

- .1 Place materials only on clean unfrozen surface, properly shaped and compacted and free from snow or ice.
- .2 Begin spreading material on crown line or high side of one-way slope.
- .3 Place materials using methods, which do not lead to segregation or degradation.
- .4 Place material to full width in uniform layers and compact to specified densities.
- .5 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .6 Remove and replace that portion of any layer in which material becomes segregated during spreading.
- .7 Where shown on Contract Drawings or as directed by Contract Administrator, scarify or bench existing slopes

in side hill or sloping sections to ensure proper bond between new materials and existing surfaces.

- .8 Where fill material consists principally of rock:
 - .1 Place to full width in layers of sufficient depth to contain maximum sized rocks, but in no case is layer thickness to exceed 1m.
 - .2 Individual rock fragments not exceeding 1.5m in horizontal dimension permitted provided their vertical dimension does not exceed one third of fill section depth.
 - .3 Carefully distribute rock material to fill voids with smaller fragments to form compact mass.
 - .4 Fill surface voids at subgrade level with rock spalls or selected material to form an earth-tight surface.
 - .5 Do not place boulders and rock fragments with dimensions exceeding 150mm within 300mm of subgrade elevation.

3.5 Compaction

- .1 Compaction equipment to be capable of obtaining required densities in materials on project.
- .2 Compact to density of not less than 95% Modified Proctor density.
- .3 Shape and roll alternately to obtain smooth, even, and uniform compacted layers.
- .4 Apply water as necessary during compaction to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment, compact to specified density with mechanical tampers.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers.
- .6 Finish slopes to neat condition, true to line and grade.
 - .1 Remove boulders encountered in cut slopes and fill resulting cavities.
 - .2 Hand finish slopes that cannot be finished satisfactory by machine.

- 3.6 Finished Tolerances**
- .1 Ensure finished subgrade surface within plus or minimum 15mm of specified grade and cross-section but not uniformly high or low.
 - .2 Ensure finished subgrade surface has no irregularities exceeding 1mm when checked with a 3m straight edge placed in any direction.
 3. Proof roll top of embankment fill upon completion of fine grading and compaction.
- 3.7 Proof Rolling**
- .1 For proof rolling use fully loaded single or dual axle dump truck.
 - .2 Contract Administrator may authorize use of other acceptable proof rolling system.
 - .3 Proof roll top of embankment full upon completion of fine grading and compaction.
 - .4 Make sufficient passes with proof roller of subject every point on surface to three separate passes of loaded tire.
 - .5 Where proof rolling reveals areas of unsuitable subgrade:
 - .1 Remove unsuitable embankment material to depth and extent directed by Contract Administrator.
 - .2 Replace with approved embankment material and compact in accordance with this section.
- 3.8 Place Topsoil**
- .1 Place, spread, and grade topsoil as shown on Contract Drawings.
 - .2 Restore planted areas with topsoil, ground cover, and plants or shrubs to match existing planted areas as shown on Contract Drawings.
- 3.9 Maintenance**
- .1 Maintain finished embankment fill in condition conforming to this section until succeeding material is applied or until granular base is accepted by Contract Administrator.

1.0 GENERAL

- .1 Section 02226 refers to those portions of the work that are unique to the supply and processing of aggregates. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.1 Related Work

- .1 Section 02226 includes specifications for aggregates and granular materials referred to in the following sections

- | | | |
|-----|--|---------------|
| .1 | Shrubs and
Tree Preservation | Section 02104 |
| .2 | Excavating, Trenching
& Backfilling | Section 02223 |
| 3. | Roadway Excavation
Embankment and
Compaction | Section 02224 |
| .4 | Granular Base | Section 02233 |
| .5 | Granular Subbase | Section 02234 |
| .6 | Unit Paving | Section 02515 |
| .7 | Portland Cement
Concrete Pavement | Section 02521 |
| .8 | Waterworks | Section 02666 |
| .9 | Storm Sewers | Section 02721 |
| .10 | Pipe Culverts | Section 02723 |
| .11 | Sanitary Sewers | Section 02731 |
| .12 | Sewage Force mains | Section 02732 |

- .2 Section 02226 does not include specifications for aggregates to be incorporated into controlled density fill. Hot-mix asphalt concrete paving, pavement crack filling, ready mixed concrete or granular materials for landscaping purposes. These specifications are as follows:

- | | | |
|----|---|---------------|
| .1 | Controlled Density Fill | Section 02236 |
| .2 | Hot-Mix Asphalt
Concrete Paving | Section 02512 |
| .3 | Pavement Crack Cleaning | Section 02577 |
| .4 | Cast in Place Concrete | Section 03300 |
| .5 | Topsoil and Finish Grading | Section 02921 |
| .6 | Seeding | Section 02933 |
| .7 | Hydraulic Seeding | Section 02934 |
| .8 | Sodding | Section 02938 |
| .9 | Planting of Trees,
Shrubs, and Ground Covers | Section 02950 |

1.2 References

- .1 The abbreviated standard specifications for testing materials, fabrication and supply, referred to herein, are fully described in References – Section 02000.

1.3 Approvals

- .1 Inform Contract Administrator of proposed source and provide samples or access for sampling at least two weeks prior to commencing production.
- .2 If materials from proposed source do not meet specified requirements locate alternative source or demonstrate that material from source in question can be processed to meet specified requirements.
- .3 Should a change of material source be proposed during work, advise Contract Administrator two (2) weeks in advance of proposed change to allow sampling and testing.
- .4 Acceptance of material does not preclude future refection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified.

1.4 Measurement & Payment

- .1 Refer to Section 02100, Measurement and Payment, Subsection 1.2, Description of Pay Items.

1.5 Inspection & Testing

- .1 Refer to General Conditions, Clause 4.12, and Inspections.

2.0 PRODUCTS

2.1 Materials – General

- .1 Gravel to be composed of inert, durable material, reasonably uniform in quality and free from soft or disintegrated particles. In absence of satisfactory performance records over five year period for particular source of material, soundness to be tested according to ASTM test procedure C-88 or latest revised issue. Maximum weight average losses for course and fine aggregates to be 30% when magnesium sulphate is used after 5 cycles.

- .2 All crushed gravel when tossed according to ASTM C-136 And ASTM C-117, or latest revised issue, to have a generally uniform gradation and conform to following gradation limits and 60% of the material passing each sieve must have one or more fractured faces.

Determination of the amount of fractured material shall be in accordance with the Ministry of Transportation and Highways' Method "A", which determines fractured faces by count. The Plasticity Index for crushed gravel to not exceed 6.0.

2.2 Native Material

- .1 To be any workable soil free of organic or foreign matter; any material obtained within limits of Contract may be deemed native material for purposes of payment if it is approved by the Contract Administrator. Native material is not acceptable if it is impractical to control its water content or compact to specified density.

2.3 Pit Run Gravel

1. To be well graded granular material substantially free from clay lumps, organic matter and other extraneous material, screened and removed all stones in excess of maximum diameter specified in material description (300 mm Pit Run Gravel, 200 mm Pit Run Gravel, 100 mm Pit Run Gravel). Material to compact to specified density and conform to following gradations.

Sieve Designation	Percent Passing	
(300 mm dia)	(100)	
(200 mm dia)	(100)	
(100 mm dia)	(100)	
75 mm	100	
50 mm	70	100
25 mm	50	100
4.75 mm	22	85
2.36 mm	10	
0.075 mm	2	8

Recycled concrete free from contaminated and other extraneous material, conforming to the specified gradations may be used as a pit run gravel.

2.4 Pit Run Sand

- .1 To be well graded pit run sand, free from organic materials and conform to following gradations:

Sieve Designation	Percent Passing	
12.5 mm		100
4.75 mm	35	100
2.36 mm	20	70
1.18 mm	13	50
0.600 mm	8	35
0.300 mm	5	25
0.150 mm	2	15
0.075 mm	0	6

2.5 River Sand

- .1 River sand to be used only where shown on Contract Drawings or otherwise specified and approved by Contract Administrator, to be free of Organic Material, salt and foreign objects that conform to the following gradations:

Sieve Designation	Percent Passing	
19 mm		100
4.75 mm	80	100
0.600 mm	20	80
0.150 mm	0	20
0.075 mm	0	8

2.6 Drain Rock

- .1

Percent Passing			
Sieve Designation	Coarse	Fine (Torpedo Gravel)	
25.0 mm	100		
19.0 mm	0 - 100		
9.5 mm	0 - 5		100
4.75 mm	0	50	100
2.36 mm		10	35
1.18 mm		5	15
0.600 mm		0	8
0.300 mm		0	5
0.150 mm		0	2
0.075 mm			0

2.7 Granular Pipe Bedding And Surround Material

- .1 Crushed or graded gravels: to conform to following gradations:

Percent Passing			
Sieve Designation	Type 1	Type 2	
25.0 mm	100		
19.0 mm	0 - 100		
12.5 mm	0 - 5		100
9.5 mm	0		100
4.75 mm	0	50	35
2.36 mm		10	15
1.18 mm		5	8
0.600 mm		0	5
0.300 mm		0	2
0.075 mm		0	0

*Type 1: standard gradation

*Type 2: to be used only in dry trench conditions and with Contract Administrator's prior approval

Recycled concrete free from contaminated and other extraneous material, conforming to the Type 1 gradations, may be used as pipe bedding and surround material.

- .2 Other permissible materials: only where shown on Contract Drawings or directed by Contract Administrator shall drain rock, pit run sand or approved native material be used for bedding and pipe surround.

2.8 Select Granular Sub-base

- .1 To be well graded granular material, substantially free from lumps and organic matter, screened if required to conform to following gradations:

Sieve Designation	Percent Passing	
75 mm		100
25 mm	50	85
0.150 mm	0	15
0.075 mm	0	8

2.9 Crushed Granular Sub-base

- .1 To be 75 mm crushed gravel conforming to following gradations:

Sieve Designation	Percent Passing	
80 mm		
75 mm		100
38 mm	60	100
25 mm		
19 mm	35	80
12.5 mm		
9.5 mm	26	60
4.75 mm	20	40
2.36 mm	15	30
1.18 mm	10	20
0.6 mm	5	15
0.3 mm	3	10
0.18 mm		
0.15 mm		
0.075 mm	0	5

2.10 Granular Base

- .1 To be 19 mm crushed gravel conforming to following gradations:

Sieve Designation	Percent Passing	
19 mm		100
12.5 mm	75	100
9.5 mm	60	90
4.75 mm	40	70
2.36 mm	27	55
1.18 mm	16	42
0.600 mm	8	30
0.300 mm	5	20
0.075 mm	2	8

2.11 Recycled Aggregate Material

- .1 Aggregates containing recycled material may be utilized if approved by the Contract Administrator. In addition to meeting all other conditions of his specification, recycled material should not reduce the quality if construction achievable with quarried materials. Recycled material should consist only of crushed Portland cement concrete;

other construction and demolition materials such as asphaltic pavements, bricks, plaster etc. are not acceptable.

3.0 EXECUTION

3.1 Handling

- .1 Handle and transport aggregates to avoid segregation, contamination and degradation.
- .2 Do not use intermixed or contaminated materials. Remove and dispose rejected materials within 48 h of rejection.

1.0 General

- .1 Section 02231 refers to those portions of the work that are unique to the requirements for scarifying and reshaping existing granular roadbeds, and where required, the supply and placement of additional granular base materials. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 This section is included for reinstatement work.

1.1 Related Work

- .1 Traffic Regulation Section 01570
- .2 Roadway Excavation, Embankment, and Compaction Section 02224
- .3 Aggregates and Granular Materials Section 02950
- .4 Dust Control Section 02242

1.2 References

- .1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in References – Section 02000.

1.3 Samples

- .1 Samples may be required.

1.4 Measurement and Payment

- .1 Refer to Section 02100, Measurement and Payment, Subsection 1.2, Description of Pay Items.

1.5 Inspection and Testing

- .1 Refer to General Conditions, Clause 4.12, Inspections.

2.0 PRODUCTS

2.1 Materials

- .1 Additional granular base material to be in accordance with Section 02233 – Granular Base and Section 02226 – Aggregates and Granular Materials.

3.0 EXECUTION

3.1 Scarifying and

Shaping

- .1 Scarify roadbed in accordance with width and depth shown on Contract Drawings.
- .2 Pulverize and break down scarified material to 19mm maximum particle size.
- .3 Blade and trim pulverized material to elevation and cross-section dimensions shown on Contract Drawings.
- .4 Where deficiency of material exists, add and blend in specified new granular base material.
- .5 Dispose excess material off-site.

3.2 Compaction

- .1 Compaction equipment to be capable of obtaining required densities in materials on project. Compact to density not less than 95% Modified Proctor density in compliance with ASTM D1557.
- .2 Shape and roll alternately to obtain smooth, even, and uniformly compacted base.
- .3 Apply water as necessary during compaction to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is suitable for compaction.
- .4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers.

3.3 Repair of Soft Areas

- .1 Correct soft areas by removing unsuitable material to depth and extent as directed by Contract Administrator. Replace with specified material and compact to specified density.

3.4 Finished Tolerances

- .1 Reshape compacted surface to within plus or minus 10mm of specified grade and cross-section but not uniformly high or low.
- .2 Ensure finished subgrade has no irregularities exceeding 10mm when checked with a 3m straight edge placed in any direction.

- .3 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.5 Maintenance

- .1 Maintain reshaped surface in condition conforming to this Section until succeeding material is applied or until reshaped roadbed is accepted by Contract Administrator.

- 1.0 General**
- .1 Section 02233 refers to those portions of the work that are unique to the supply and placement of granular base materials. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
 - .2 This section is included for reinstatement work.
- 1.1 Related Work**
- .1 Traffic Regulation Section 01570
 - .2 Aggregates and Granular Materials Section 02950
 - .3 Dust Control Section 02242
- 1.2 References**
- .1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in References – Section 02000.
- 1.3 Samples**
- .1 Samples may be required.
- 1.4 Measurement and Payment**
- .1 Refer to Section 02100, Measurement and Payment, Subsection 1.2, Description of Pay Items.
- 1.5 Inspection and Testing**
- .1 Refer to General Conditions, Clause 4.12, Inspections.
- 2.0 PRODUCTS**
- 2.1 Granular Base**
- .1 Material for road base to be:
 - .1 19mm crushed gravel.
 - .2 Refer to Section 02226 – Aggregates and Granular Materials for material specifications.
- 3.0 EXECUTION**
- 3.1 Inspection of Underlying Subbase**
- .1 Ensure underlying subbase surface true to cross-section and grade, and of the specified material compacted to

95% Modified Proctor density in compliance with ASTM D1557. Do not place granular base until finished subbase surface is inspected and approved by Contract Administrator.

3.2 Placing

- .1 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow or ice.
- .2 Begin spreading base material on crown line or on high side of one-way slope.
- .3 Place base material using methods which do not lead to segregation or degradation of aggregate.
- .4 Place material to full width in uniform layers not exceeding 150mm compacted thickness. Contract Administrator may authorize thicker layers if specified compaction can be achieved.
- .5 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .6 Remove and replace portion of any layer in which material has become segregated during spreading.

3.3 Compaction

- .1 Compaction equipment to be capable of obtaining required densities in materials on project.
- .2 Compact to density not less than 95% Modified Proctor density.
- .3 Shape and roll alternately to obtain smooth, even, and uniformly compacted base.
- .4 Apply water as necessary during compacting to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is suitable for compaction.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers.

- 3.4 Finished Tolerances**
- .1 Ensure finished base surface within plus or minus 10mm of specified grade and cross-section but not uniformly high or low.
 - .2 Ensure finished surface has no irregularities exceeding 10mm when checked with a 3m straight edge placed in any direction.
 - .3 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

- 3.5 Proof Rolling**
- .1 For proof rolling use fully loaded single or dual axle dump truck.
 - .2 Contract Administrator may authorize use of other acceptable proof rolling equipment.
 - .3 Proof roll top of base upon completion of fine grading and compaction.
 - .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
 - .5 Where proof rolling reveals areas of unsuitable subgrade:
 - .1 Remove base, subbase, and subgrade material depth and extent as directed by Contract Administrator.
 - .2 Backfill excavated subgrade with approved embankment material and compact in accordance with Section 02224 – Roadway Excavation, Embankment, and Compaction.
 - .3 Replace subbase material and compact in accordance with Section 02234 – Granular Subbase.
 - .4 Replace base material and compact in accordance with this Section.
 - .6 Where proof rolling reveals areas of unsuitable base or subbase, remove unsuitable materials to depth and extent directed by Contract Administrator and replace with new materials in accordance with Section 02234 – Granular Subbase and this Section at no extra cost.

3.6 Maintenance

- .1 Maintain finished base in condition conforming to the section until succeeding material is applied or until granular base is accepted by Contract Administrator.

1.0 GENERAL

- .1 Section 02498 refers to those portions of the work that are unique to the supply and installation of geosynthetic materials. Geosynthetics include Geotextiles, Geogrids, Geocomposites, and Geomembranes. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 Geotextiles are typically either a “silt-film, woven” variety or a “continuous filament” variety. Geotextiles may be used for separation, filtration, and reinforcement. Geogrids may be used for reinforcement. Geocomposites may be used for drainage and for separation/reinforcement or drainage/reinforcement. Geomembranes may be used for impermeable barriers.

1.1 Related Work

- .1 Environmental Protection Section 01561
- .2 Roadway Excavation, Embankment,
And Compaction Section 02224
- .3 Riprap Section 02271

1.2 References

- .1 The abbreviated standard specifications for testing, materials, fabrication, supply, and installation, referred to herein, are fully described in References – Section 02000.
- .2 American Society for Testing and Materials (ASTM)
 - .1 D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting
 - .2 D 1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
 - .3 D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
 - .4 D 1603 Test Method for Carbon Black in Olefin Plastics
 - .5 D 3895 Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
 - .6 D 4218 Standard Test Method for Determination of Carbon Black in Polyethylene Compounds
 - .7 D 4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

- .8 D 5199 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
- .9 D 5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
- .10 D 5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
- .11 D 5994 Standard Test Method for Measuring Core Thickness of Textured Geomembranes
- .12 D 6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
- .13 D 6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
- .3 Geosynthetic Research Institute
 - .1 GRI GM 13 Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
 - .2 GRI GM 17 Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes

1.3 Samples

- .1 Samples may be required.

1.4 Material Certification

- .1 Submit a "General Product Certification Sheet" clearly showing "Minimum Average Roll Values", as governed by ASTM D4354, with tender documents. All values to meet or exceed specified requirements.
- .2 At least 2 weeks prior to commencing work, and prior to material being accepted on site, submit original manufacturer's "Mill Certificates", showing actual MINIMUM test values and clearly identifying roll and batch numbers. Any material arriving on site which does not meet or exceed accepted "Minimum Average Roll

Values” or that are not identified on original manufacturer’s mill certification document to be removed at no cost to Owner.

- .3 All rolls of geosynthetics arriving on site to be clearly labelled identifying roll and batch number, original manufacturer’s product identification number, and width and length of material contained within roll.

1.5 Delivery and Storage

- .1 Ensure each individual roll of geosynthetic is wrapped and covered to protect fabric from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, debris, and rodents.
- .2 Use equipment that does not contact material itself during loading, unloading, and handling. Slings or other lifting devices to provide adequate support without damaging material. Off-load in a minimum of steps directly to storage or installation area.
- .3 Store all rolls of geosynthetics on smooth, flat surfaces raised above ground that provide continuous support to rolls. Maintain additional protective cover if rolls are to be stored in excess of 30 days.

1.6 Measurement and Payment

- .1 Refer to Section 02100, Measurement and Payment, Subsection 1.2, Description of Pay Items.

1.7 Inspection and Testing

- .1 Refer to General Conditions, Clause 4.12, Inspections.

2.0 PRODUCTS

2.1 Geosynthetic

- .1 Geosynthetic: see detailed specification in Supplementary Specifications or as shown on Contract Drawings.
- .2 Notwithstanding above, all specified properties represent “Minimum Average Roll Values” as governed by ASTM D4354.

- .3 Sewn seam (geotextiles) to be constructed using a 'j' configuration with 5 to 8 stitches per 25mm in each of 2 lines of stitching separated by at least 12mm. Stitches to be such that they will have an elongation at break equal to or greater than geosynthetic when tested in plane of seam. Ultimate grab strength perpendicular to seam to be equal to or exceed 90% of grab tensile strength of geosynthetic specified in Supplementary Specifications or on Contract Drawings.
- .4 Thread for sewn seams (geotextiles) to have an equal or better resistance to chemical and biological degradation as that of geosynthetic. For inspection purposes, thread used to be of a color that will contrast with original geosynthetic. Threads comprising of any organic fibres (such as cotton) or nylon will not be accepted.
- .5 Seams for all other geosynthetics to be to manufacturer's recommendations.

3.0 EXECUTION

3.1 Installation

- .1 Geotextiles:
 - .1 Where fabric seams are not sewn, ensure overlaps conform to Supplementary Specifications or as shown on Contract Drawings, but under no circumstances less than 600mm.
 - .2 When placing fabric which incorporates a sewn seam, place seam "thread up" to facilitate inspection and repair.
 - .3 Place pins or staples, where used, at a maximum of 2m intervals.
 - .4 Minimum granular thicknesses:
 - .1 Minimum lift thicknesses, prior to compaction with non-vibratory equipment to be 300mm.
 - .2 Minimum base course thickness prior to further compaction with vibratory equipment to be 600mm (pre-compacted) as above.

.2 Geomembranes:

.1 Equipment:

.1 Welding equipment and accessories shall meet the following requirements:

.1 Gauges showing temperatures in apparatus (extrusion welder) or wedge (wedge welder) shall be present.

.2 An adequate number of welding apparatus shall be available to avoid delaying work.

.3 Power source must be capable of providing constant voltage under combined line load.

.2 Deployment:

.1 Assign each panel a simple and logical identifying code. The coding system shall be subject to approval and shall be determined at the job site.

.2 Visually inspect the geomembrane during deployment for imperfections and mark faulty or suspect areas.

.3 Deployment of geomembrane panels shall be performed in a manner that will comply with the following guidelines:

.1 Unroll geomembrane using methods that will not damage geomembrane and will protect underlying surface from damage (spreader bar, protected equipment bucket).

.2 Place ballast (commonly sandbags) on geomembrane which will not damage geomembrane to prevent wind uplift.

.3 Personnel walking on geomembrane shall not engage in activities or wear shoes that could damage it. Smoking will not be permitted on the geomembrane.

.4 Do not allow heavy vehicular traffic directly on geomembrane. Rubber-tired ATV's and trucks are acceptable if wheel contact is less than 6 psi.

.5 Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.

.4 Sufficient material (slack) shall be provided to allow for thermal expansion and contraction of the material.

.3 Field Seaming:

.1 Seams shall meet the following requirements:

.1 To the maximum extent possible, orient seams parallel to line of slope, i.e., down and not across slope.

.2 Minimize number of field seams in corners, odd-shaped geometric locations and outside corners.

.3 Slope seams (panels) shall extend a minimum of five-feet beyond the grade break into the flat area.

.4 Use a sequential seam numbering system compatible with panel numbering system that is agreeable to the CONSULTANT and INSTALLER.

.5 Align seam overlaps consistent with the requirements of the welding equipment being used. A 6-inch overlap is commonly suggested.

.2 During welding operations provide at least one Master Seamer who shall provide direct supervision over other welders as necessary.

.3 Extrusion Welding:

.1 Hot-air tack adjacent pieces together using procedures that do not damage the geomembrane.

.2 Clean geomembrane surfaces by disc grinder or equivalent.

.3 Purge welding apparatus of heat-degraded extrudate before welding.

.4 Hot Wedge Welding:

.1 Welding apparatus shall be a self-propelled device equipped with an electronic controller which displays applicable temperatures.

.2 Clean seam area of dust, mud, moisture and debris immediately ahead of hot wedge welder.

.3 Protect against moisture build-up between sheets.

.5 Trial Welds

.1 Perform trial welds on geomembrane samples to verify welding equipment is operating properly.

.2 Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.

.3 Minimum of two trial welds per day, per welding apparatus, one made prior to the start of work and one completed at mid shift.

.4 Cut four, one-inch wide by six-inch long test strips from the trial weld.

.5 Quantitatively test specimens for peel adhesion, and then for shear strength.

.6 Trial weld specimens shall pass when the results shown in Table 3 are achieved in both peel and shear test. The break, when peel testing, occurs in the liner material itself, not through peel separation (FTB). The break is ductile.

.7 Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.

.8 No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed trial weld.

.6 Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. INSTALLER shall demonstrate that acceptable seaming can be performed by completing acceptable trial welds.

.7 Defects and Repairs:

.1 Examine all seams and non-seam areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.

.2 Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.

3.2 Protection

- .1 Do not permit passage of any vehicle directly on geosynthetic at any time. Place fill by end-dumping or long-reach equipment.
- .2 Maximum drop height for fill directly onto geosynthetic to not exceed 1m.

3.3 Repairs

- .1 Repair seams which open, and tears and punctures, by removing fill and resetting fabric. Additional geosynthetic to be placed over area, extending beyond perimeter of failure a distance corresponding to lapping requirements for project. See 3.1.1 above. Where practical, repaired geosynthetic to be pinned, bonded, or stapled into place at intervals equal to or less than one-eighth perimeter of damage or 2m, whichever is lesser.

1.0 GENERAL

- .1 Section 02512 refers to those portions of the work that are unique to the supply and placement of hot-mix asphalt concrete paving. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 This section is included for reinstatement work.

1.1 Related Work

- .1 Traffic Control, Vehicle Access and Parking Section 01570
- .2 Aggregates and Granular Material Section 02226
- .3 Reshaping Granular Roadbed Section 02231
- .4 Asphalt Prime Section 02546
- .5 Asphalt Tack Coat Section 02547
- .6 Full Depth Reclamation Section 02575
- .6 Excavating, Trenching and Backfilling Section 02223

1.2 References

- .1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Section 02000 - Reference Specifications- Site and Infrastructure.

**1.3 Material
Certification**

- .1 Upon request from Contract Administrator, submit manufacturer's test data and certification that asphalt cement material meets requirements of this section.

**1.4 Submission of
Mix Design**

- .1 Submit asphalt concrete mix design and trial mix test results to Contract Administrator for review at least one week prior to commencing work

**1.5 Measurement
and Payment**

- .1 Refer to Section 02100, Measurement and Payment, Subsection 1.2, Description of Pay Items.

**1.5 Inspection and
Testing**

- .1 Refer to General Conditions, Clause 4.12, Inspections.
- .2 Testing laboratory to be approved by Contract Administration

2.0 PRODUCTS

2.1 Materials

- .1 Asphalt cement: to CAN/CGSB – 16.3-M90, grade 80 -100.
- .2 Reclaimed asphalt pavement (RAP): Crush and screen so that 100% of reclaimed asphalt pavement material passes 37.5 mm screen before mixing.
- .3 Aggregates: to Section 02226 - Aggregates and Granular Materials and following requirements:
 - .1 Crushed stone or gravel consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
 - .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117

Sieve Designation		Percent Passing				
		* Lower Course #1	* Lower Course #2	* Upper Course #1	* Upper Course #2	* Fine Mix
25.0	mm	100	-	-	-	-
19.0	mm	-	100	100		
12.5	mm	70 - 85	84 - 99	84 - 99	100	
9.5	mm	-	73 - 88	73 - 88		100
4.75	mm	40 - 65	50 - 68	50 - 68	55 - 75	80 - 100
2.36	mm	32 - 53	35 - 55	35 - 55	38 - 58	64 - 89
1.18	mm	26 - 44	27 - 46	27 - 46	28 - 47	48 - 76
0.600	mm	18 - 36	18 - 36	18 - 36	20 - 36	32 - 60
0.300	mm	10 - 26	10 - 26	10 - 26	10 - 26	16 - 42
0.15	mm	4 - 17	4 - 17	4 - 17	4 - 17	6 - 23
0.075	mm	3 - 8	3 - 8	3 - 8	3 - 8	4 - 10

*Footnote to asphalt mix-type selection:

Lower Course #1: Arterial and collector, lower course only.

Lower Course #2: Local, lower course only.

Upper Course #1: Arterial and collector, upper course only.

Upper Course #2: Local, surface course only

Fine Mix: Skim patch on existing asphalt surface

- .3 Coarse aggregate is aggregate retained on 4.75 mm sieve and fine aggregate is aggregate passing 4.75 mm sieve when tested to ASTM C136.
- .4 When dryer drum plant or plant without hot screening is used, process fine aggregate through 4.75 mm sieve and stockpile separately from coarse aggregate.
- .5 Do not use aggregates having known polishing characteristics in mixes for upper courses.
- .6 Sand equivalent: to ASTM D2419: Min:40
- .7 Magnesium Sulphate soundness: to ASTM C88.
Max % loss by mass after five cycles:
 - .1 Coarse aggregate: 15
 - .2 Fine aggregate: 18
- .8 Los Angeles abrasion: Grading B, to ASTM C131
Max % loss by mass:
 - .1 Coarse aggregate, upper course: 25
 - .2 Coarse aggregate, lower course: 35
- .9 Absorption: to ASTM C127.
Max % by mass:
 - .1 Coarse aggregate, upper course: 1.75
 - .2 Coarse aggregate, lower course: 2.00
- .10 Loss by washing: to ASTM C117.
Max % passing 0.075 mm sieve:
 - .1 Coarse aggregate, upper course: 1.5
 - .2 Coarse aggregate, lower course: 2.0
- .11 Flat and elongated particles: (with length to thickness ratio greater than 3):
Max % by mass:
 - .1 Coarse aggregate, upper course: 10
 - .2 Coarse aggregate, lower course: 10
- .12 Crushed fragments: at least 60% of particles by mass within each of following sieve designation ranges, to have at least 2 freshly fractured faces. Material to be tested according to ASTM C136 and ASTM C117.

Determination of amount of fractured material will be in accordance with Ministry of Transportation and Highways' Specification I-11, Fracture Count for Coarse Aggregate, Method "B", which determines fractured faces by mass.

Passing		Retained On
25mm	to	12.5mm
12.5mm	to	4.75mm

- .13 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance
- .4 Mineral filler:
 - .1 Finely ground particles of limestone, hydrated lime, Portland cement or other approved non-plastic mineral matter, thoroughly dry and free from lumps.
 - .2 Add mineral filler when necessary to meet job mix aggregate gradation or as directed to improve mix properties.
 - .3 Mineral filler to be dry and free flowing when added to aggregate.

2.2 Mix Design

- .1 Submit job mix formula to Contract Administrator for review and approval.
- .2 Mix may contain up to a maximum 20% by mass of RAP without a special mix design. Contract Administrator may approve higher proportion of RAP if Contractor demonstrates ability to produce mix meeting requirements of specification.
- .3 Design of mix: by Marshall method to requirements below:
 - .1 Compaction blows on each face of test specimens: 75
 - .2 Mix physical requirements:

Property		Pavement Course	
Marshall Stability at 60° C	kN min.	6.4	lower course
		5.5	upper course
		5.5	fine
Flow Value	mm	2 - 4	

Air Voids in Mixture	%	3 - 6	lower course
		3 - 5	upper course
		3 - 5	fine
		13	lower course 1
		14	lower course 2
		14	upper course 1
		15	upper course 2
		15	fine
Index of Retained Stability	% min.	75	

- .3 Measure physical requirements as follows:
 - .1 Marshall load and flow value: to ASTM D1559
 - .2 Air voids: to ASTM D3203
 - .3 Index of Retained Stability: measure in accordance with Marshall Immersion Test (ASTM D1559).
 - .4 Do not change job-mix without prior approval of Contract Administrator. Should change in material source be proposed, new job-mix formula to be submitted to Contract Administrator for review and approval.

3.0 EXECUTION

3.1 Plant and Mixing Requirements

- .1 Batch and continuous mixing plants:
 - .1 To ASTM D995
 - .2 Heat asphalt cement and aggregate to mixing temperature. Do not heat asphalt cement above 160°C.
 - .3 Before mixing, dry aggregates to a moisture content not greater than 0.5% by mass or to a lesser moisture content if required to meet mix design requirements.
 - .4 Contract Administrator will monitor temperature of completed mix at plant and at paver after considering hauling and placing conditions.

- .5 Feed aggregates from individual stockpiles through separate bins to cold elevator feeders.
- .6 Feed cold aggregates to plant in proportions that will ensure continuous operations.
- .7 Immediately after drying, screen aggregates into hot storage bins in sizes to permit recombining into gradation meeting job- mix requirements .
- .8 Store hot screened aggregates in a manner to minimize segregation and temperature loss.
- .9 Where RAP is to be incorporated into mix:
 - .1 Feed from separate cold feed bin specially designed to minimize consolidation of material. Provide 37.5 mm scalping screen on cold feed to remove oversized pieces of RAP.
 - .2 Ensure positive and accurate control of RAP cold feed by use of hydraulic motor or electric clutch and equip with anti-rollback device to prevent material from sliding backward on feed belt.
 - .3 Combine RAP and new aggregates in proportions as specified. Dry mix thoroughly, until uniform temperature within plus or minus 5° C of mix temperature is achieved prior to adding new asphalt cement. Do not add new asphalt cement where temperature of dry mix material is above 160°C.
- .10 Maintain temperature of materials within plus or minus 5° C of specified mix temperature during mixing.
- .11 Mixing time:
 - .1 In batch plants, dry mix for not less than 10 s. Continue wet mixing as long as necessary to obtain a thoroughly blended mix but not less than 30 s or more than 75 s.
 - .2 In continuous mixing plants, mixing time as required but not less than 45 s.
- .2 Dryer drum mixing plant:
 - .1 Where RAP to be incorporated into mix, dryer drum mixer to be designed to prevent direct contact of RAP with burner flame or with exhaust gases hotter than 180°C.

- .2 Feed aggregates to burner end of dryer drum by means of a multi-bin cold feed unit and blend to meet job-mix requirements by adjustments of variable speed feed belts and gates on each bin.
 - .3 Feed RAP from separate cold feed bin designed to minimize reconsolidation of material.
 - .4 Meter total flow of aggregate and RAP by electronic weigh belt system with an indicator that can be monitored by plant operator and which is interlocked with asphalt pump so that proportions of aggregate and RAP and asphalt entering mixer remain constant.
 - .5 Provide for easy calibration of weighing systems for aggregates and RAP without having material enter mixer.
 - .6 Make provision for conveniently sampling full flow of materials from the cold feed.
 - .7 Provide screens or other suitable devices to reject oversize particles or lumps of aggregate and RAP from cold feed prior to entering drum.
 - .8 Provide a system interlock which will stop all feed components if either asphalt or aggregate from any bin stops flowing.
 - .9 Accomplish heating and mixing of asphalt mix in a drum dryer-mixer. Control heating to prevent fracture of aggregate or excessive oxidation of asphalt. Equip system with automatic burner controls and provide for continuous temperature sensing of asphalt mixture at discharge, with a printing recorder that can be monitored by plant operator. Submit printed record of mix temperatures at end of each week, if required.
 - .10 Mixing period and temperature to produce a uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves mixer to be less than 0.5%.
- .3 Temporary storage of hot mix:
- .1 Provide mix storage of sufficient capacity to permit continuous operation, maintained at specified temperatures and designed to prevent segregation.
 - .2 Do not store asphalt mix in storage bins in excess of 12 h.

.4 Mixing tolerances:

- .1 Permissible variation in aggregate gradation from job mix (percent of total mass):
 - .1 4.75 mm sieve & larger 5.5
 - .2 2.36 mm sieve 4.5
 - .3 0.600 mm sieve 3.5
 - .4 0.150 mm sieve 2.5
 - .5 0.075 mm sieve 1.5
- .2 Permissible variation of asphalt cement from job mix, 0.3%.
- .3 Permissible variation of mix temperature at discharge from plant, 5° C.

3.2 Equipment

- .1 Pavers: mechanical grade-controlled self-powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown as shown on Contract Drawings.
- .2 Rollers: sufficient number of rollers of type and weight to obtain specified density of compacted mix.
- .3 Vibratory rollers:
 - .1 Minimum drum diameter: 1200 mm.
 - .2 Maximum amplitude of vibration (machine setting): 0.5 mm for lifts less than 40 mm thick.
- .4 Haul trucks: of adequate size, speed and condition to ensure orderly and continuous operation and as follows:
 - .1 Boxes with tight metal bottoms.
 - .2 Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.
 - .3 In cool weather or for long hauls, insulate entire contact area of each truck box.
 - .4 Trucks which cannot be weighed in a single operation on scales supplied will not be accepted.
- .5 Hand tools:
 - .1 Lutes or rakes with covered teeth for spreading and finishing operations .
 - .2 Tamping irons having mass not less than 12 kg and a bearing area not exceeding 310 cm² for compacting material along curbs, gutters and other structures inaccessible to roller. Mechanical compaction equipment, when approved by Contract Administrator, may be used instead of tamping irons.
 - .3 Straight edges, 3.0 min length, to test finished surface.

3.3 Preparation

- .1 Reshape granular roadbed in accordance with Section 02231 – Reshaping Granular Roadbed, Section 02520 - Roller Compacted Concrete Paving and Section 02575 - Full Depth Reclamation, if required.
- .2 When paving over existing asphalt surface, clean pavement surface in accordance with Section 02581- Pavement Surface Cleaning and Removal of Pavement Markings. When levelling course is not required, patch and correct depressions and other irregularities to approval of Contract Administrator before beginning paving operations.
- .3 Adjust existing castings to new elevations and protect from asphaltic mix.
- .4 When matching new pavement with existing pavement make vertical cut between existing pavement and new pavement as shown on Contract Drawings.
- .5 Apply prime coat and/or tack coat in accordance with Section 02546 - Asphalt Prime and/or Section 02547 - Asphalt Tack Coat prior to paving.
- .6 Prior to laying mix, clean surfaces of loose and foreign material.

3.4 Transportation of Mix

- .1 Transport mix to job site in vehicles cleaned of foreign material.
- .2 Paint or spray truck beds with light oil, limewater, soap or detergent solution, at least once a day or as required. Elevate truck bed and thoroughly drain. No excess solution will be permitted.
- .3 Schedule delivery of material for placing in daylight, unless Contract Administrator approves artificial light.
- .4 Deliver material to paver at a uniform rate and in an amount within capacity of paving and compacting equipment.
- .5 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at temperature within specified range. Temperature of mix upon placement shall not be less than 125°C.

3.5 Placing

- .1 Obtain Contract Administrator's approval of base, existing surface, tack coat, or prime coat prior to placing asphalt.
- .2 Place asphalt concrete to thicknesses, grades and lines as shown on Contract Drawings.

- .3 Placing conditions:
 - .1 Place asphalt mixtures only when air temperature is above 5°C. Place overlay pavement only when air temperature is above 10° C.
 - .2 When temperature of surface on which material is to be placed falls below 10°C, provide extra rollers as necessary to obtain required compaction before cooling.
 - .3 Do not place hot-mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.
- .4 Place asphalt concrete in compacted lifts of thickness as shown on Contract Drawings:
 - .1 Levelling course(s) to thicknesses required but not exceeding 100 mm each.
 - .2 Lower course in layers not to exceed 100 mm each.
 - .3 Surface course in layers of maximum 60 mm each.
- .5 Where possible do tapering and levelling where required in lower lifts. Overlap joints by not less than 300 mm.
- .6 Spread and strike off mixture with self-propelled mechanical finisher.
 - .1 Construct longitudinal joints and edges true to line markings. Position and operate paver to follow established line closely.
 - .2 When using pavers in echelon, have first paver follow marks or lines, and second paver follow edge of material placed by first paver. Work pavers as close together as possible and in no case permit them to be more than 30m apart.
 - .3 If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.
 - .4 Correct irregularities in alignment left by paver by trimming directly behind machine.
 - .5 Correct irregularities in surface of pavement course directly behind paver. Remove by shovel or lute excess material forming high spots. Fill and smooth indented areas with hot mix. Do not broadcast material over such areas.
 - .6 Do not throw surplus material on freshly screeded surfaces.
- .7 When hand spreading is used:

- .1 Approved wood or steel forms, rigidly supported to assure correct grade and cross section, may be used. Use measuring blocks and intermediate strips to aid in obtaining required cross-section.
- .2 Distribute material uniformly. Do not broadcast material.
- .3 During spreading operation, thoroughly loosen and uniformly distribute material by lutes or covered rakes. Reject material that has formed into lumps and does not break down readily.
- .4 After placing and before rolling, check surface with templates and straightedges and correct irregularities.
- .5 Provide heating equipment to keep hand tools free from asphalt. Avoid high temperatures which may burn material. Do not use tools at a higher temperature than temperature of mix being placed.

3.6 Compaction

- .1 Roll asphalt continuously to average density not less than 97% of 75 blow Marshall density in accordance with ASTM D1559 with no individual test less than 95%.
- .2 General:
 - .1 Provide at least two rollers and as many additional rollers as necessary to achieve specified pavement density. When more than two rollers are required, one roller to be pneumatic tired type.
 - .2 Start rolling operations as soon as placed mix can bear weight of roller without undue displacement of material or cracking of surface.
 - .3 Operate roller slowly initially to avoid displacement of material. For subsequent rolling do not exceed 5 km/h for static steel- wheeled rollers and 8 km/h for pneumatic- tired rollers.
 - .4 For lifts 50 mm thick and greater, adjust speed and vibration frequency of vibratory rollers to produce minimum of 20 impacts per metre of travel. For lifts less than 50 mm thick, impact spacing should not exceed compacted lift thickness.
 - .5 Overlap successive passes of roller by at least one half width of roller and vary pass lengths.
 - .6 Keep wheels of roller slightly moistened with water to prevent pick-up of material but do not over-water.
 - .7 Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism operating.

- .8 Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.
- .9 After traverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side.
- .10 When paving in echelon, leave unrolled 50 to 75 mm of edge which second paver is following and roll when joint between lanes is rolled.
- .11 Where rolling causes displacement of material, loosen affected areas at once with lutes or shovels and restore to original grade of loose material before re-rolling.
- .3 Breakdown rolling:
 - .1 Commence breakdown rolling immediately following rolling of transverse and longitudinal joint and edges.
 - .2 Operate rollers as close to paver as necessary to obtain adequate density without causing undue displacement.
 - .3 Operate breakdown roller with drive roll or wheel nearest finishing machine. Exceptions may be made when working on steep slopes or super-elevated sections.
 - .4 Use only experienced roller operators for this work.
- .4 Second rolling:
 - .1 Use pneumatic-tired, steel wheel or vibratory rollers and follow breakdown rolling as closely as possible and while paving mix temperature allows maximum density from this operation.
 - .2 Rolling to be continuous after initial rolling until mix placed has been thoroughly compacted.
- .5 Finish rolling:
 - .1 Accomplish finish rolling with steel wheel rollers while material is still warm enough for removal of roller marks.
 - .2 Conduct rolling operations in close sequence.

3.7 Joints

- .1 General:
 - .1 Remove surplus material from surface of previously laid strip. Do not dispose on surface of freshly laid strip.
 - .2 Construct joints between asphalt concrete pavement and portland cement concrete pavement as specified.
 - .3 Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material prior to placing adjacent pavement.

- .2 Transverse joints:
 - .1 Offset transverse joint in succeeding lifts by at least 600 mm.
 - .2 Cut back to full depth vertical face and tack face with thin coat of asphalt prior to continuing paving.
 - .3 Compact transverse joints to provide a smooth riding surface.
- .3 Longitudinal joints:
 - .1 Offset longitudinal joints in succeeding lifts by at least 150 mm.
 - .2 Cold joint is defined as joint where asphalt mix is placed, compacted and left to cool below 100°C prior to paving of adjacent lane. If cold joint cannot be avoided, tack face of adjacent lane with thin coat of asphalt prior to continuing paving.
 - .3 Overlap previously laid strip with spreader by 100 mm.
 - .4 Before rolling, carefully remove and discard coarse aggregate in material overlapping joint with a lute or rake.
 - .5 Roll longitudinal joints directly behind paving operation.
 - .6 When rolling with static roller, shift roller over onto previously placed lane in order that 100 to 150 mm of drum width rides on newly laid lane, then operate roller to pinch and press fines gradually across joint. Continue rolling until thoroughly compacted neat joint is obtained.
 - .7 When rolling with vibratory roller, have most of drum width ride on newly placed lane with remaining 100 to 150 mm extending onto previously placed and compacted lane.
- .4 Construct feather joints so that thinner portion of joint contains fine graded material obtained by changed mix design or by raking out coarse aggregate in mix. Place and compact joint so that joint is smooth and without visible breaks in grade. Location of feather joint as specified.
- .5 Construct butt joints at locations and to details as shown on Contract Drawings.
- .6 Wherever practical, locate joints under future traffic markings (paint lines).

3.8 Pavement Patching

- .1 Ensure temporary and permanent pavement patching done by handwork conforms to all standards specified for machine placed asphaltic concrete.

- .2 Sub-base and base preparation as specified in Section 02234 - Granular Sub-base and Section 02233 - Granular Base respectively, unless shown otherwise on Contract Drawings.

3.9 Sidewalks, Driveways and Curbs

- .1 Hot-mix asphalt concrete sidewalks, driveways and curbs as shown on Contract Drawings.
- .2 Machine place where practical.
- .3 Ensure placement by handwork conforms to all standards specified for machine placed asphaltic concrete.
- .4 Other than requirements relating specifically to Portland cement concrete, ensure hot-mix asphalt concrete sidewalks and curbs comply with all requirements of Section - 02523 Concrete Walks, Curbs and Gutters.
- .5 Ensure hot-mix asphalt concrete driveways comply with all requirements of Section 02512 - Hot-Mix Asphalt Concrete Paving.

3.10 Finished Tolerances

- .1 Ensure finished asphalt surface within 6 mm of design elevation but not uniformly high or low.
- .2 Ensure finished asphalt surface does not have irregularities exceeding 6 mm when checked with a 3m straight edge placed in any direction.
- .3 Water pending not permitted.
- .4 Against concrete gutter, finished asphalt surface to be higher than the gutter by not more than 6mm.

3.11 Defective Work

- .1 Correct irregularities which develop before completion of rolling by loosening upper mix and removing or adding material as required.
- .2 If irregularities or defects remain after final compaction, remove upper course promptly and lay new material to form a true and even surface and compact immediately to specified density.

3.12 Clean-Up

- .1 Remove lids or covers from all castings and clean any prime, tack coat or hot- mix asphaltic concrete from frames, lids and covers of all castings.

END OF SECTION

1.0 GENERAL

- .1 Section 02546 refers to those portions of the work that are unique to the supply and application of asphalt prime coat. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 This section is included for reinstatement work.

1.1 Related Work

- .1 Traffic Control, Vehicle Access and Parking Section 01570
- .2 Reshaping Granular Roadbed Section 02231
- .3 Granular Base Section 02226
- .4 Hot-mix Asphalt Concrete Paving Section 02512

1.2 References

- .1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Section 02000 - Reference Specifications- Site and Infrastructure.

1.3 Samples

- .1 Provide access on tanker for Contract Administrator to sample asphalt material to be incorporated into work, in accordance with ASTM D140.

1.4 Asphalt Material Certification

- .1 Upon request from Contract Administrator, submit manufacturer's test data and certification that asphalt prime material meets requirements of this section.

1.5 Measurement and Payment

- .1 Refer to Section 02100, Measurement and Payment, Subsection 1.2, Description of Pay Items.
- .2 Payment for sand blotter will be made if its use is necessary due to conditions beyond control of Contractor and approved by Contract Administrator.

1.5 Inspection and Testing

- .1 Refer to General Conditions, Clause 4.12, Inspections.

2.0 PRODUCTS

2.1 Materials

- .1 Asphalt material: to CAN/CGSB – 16.1, grade RM-20, MC-70 or CAN/CGSB – 16.2, grade SS-1h, as specified in Supplementary Specifications.
- .2 Sand blotter: clean granular material passing 4.75 mm sieve and free from organic matter or other deleterious materials.

3.0 EXECUTION

3.1 Equipment

- .1 Pressure Distributor:
 - .1 Designed, equipped, maintained and operated so that asphalt material at even temperature may be applied uniformly on variable widths of surface up to 5 m, readily determined and controlled rates from 0.2 to 5.4 L/m² with uniform pressure, and with an allowable variation from any specified rate not exceeding 5.4 L/m².
 - .2 Capable of distributing asphalt material in uniform spray without atomization at temperature required.
 - .3 Equipped with meter registering metres of travel per minute visibly located to enable truck driver to maintain constant speed required for application at specified rate.
 - .4 Pump equipped with flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator. Pump to operate by separate power unit independent of truck power unit.
 - .5 Equipped with an easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
 - .6 Equipped with accurate volume measuring device or calibrated tank.
 - .7 Nozzles to be of same make and dimensions, adjustable for fan width and orientation.
- .2 Hand Sprayer: For small and/or inaccessible areas, a pressurized hand-held spray wand may be used.

3.2 Application

- .1 Obtain Contract Administrator's approval of granular base surface before applying asphalt prime.
- .2 Cutback asphalt:
 - .1 Heat MC70 asphalt prime to 60 to 70°C for pumping and spraying in accordance with manufacturer's instructions. For other grades refer to appropriate material section.
 - .2 Apply asphalt prime to granular base at rate as required but do not exceed 2 L/m².
 - .3 Apply on damp surface unless otherwise directed by Contract Administrator.
- .3 Emulsified asphalt:
 - .1 Dilute asphalt emulsion with clean water at 1 : 1 ratio for application. Mix thoroughly.
 - .2 Apply diluted asphalt emulsion at rate as required but do not exceed 5 L/m².
 - .3 Apply on damp surface unless otherwise directed by Contract Administrator.
- .4 Paint contact surfaces of curbs, gutters, manholes and like structures with thin, uniform coat of asphalt prime material.
- .5 Do not apply prime when air temperature is less than 5° C or when rain is forecast within 2 h of application.
- .6 Where traffic is to be maintained, treat no more than one-half width of surface in one application.
- .7 Prevent excessive overlap at junction of spreads.
- .8 Do not prime surfaces that will be visible when paving is complete.
- .9 Apply additional prime to areas not sufficiently covered.
- .10 Keep traffic off primed areas until asphalt prime has cured.
- .11 Permit prime to cure before placing asphalt paving.

3.3 Use of Sand Blotter

- .1 If asphalt prime fails to penetrate within 24 h, spread sand blotter material in amounts required to absorb excess material.

.2 Sweep and remove excess blotter material.

END OF SECTION

1.0 GENERAL

- .1 Section 02666 refers to those portions of the work that are unique to the supply and installation of water mains, hydrants, valves and valve boxes, service connections and related appurtenances. This Section must be referenced to and interpreted simultaneously with all other Sections pertinent to the works described herein.
- .2 All details of waterworks facilities not specifically covered in this Section to comply with respective AWWA standards and/or manuals of practice as specified in Contract Documents.

1.1 Related Work

- .1 Excavating, Trenching and Backfilling Section 02223
- .2 Manholes and Catchbasins Section 02725
- .3 Concrete Reinforcement Section 03200
- .4 Cast-in-Place Concrete Section 03300
- .5 PreCast Concrete – Section 03400
- .6 Aggregates & Granular Materials Section 02950
- .7 Cathodic Protection Section 02642

1.2 References

- .1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Section 02000 - Reference Specifications – Site and Infrastructure.

1.3 Samples

- .1 Samples may be required.

1.4 Material Certification

- .1 Products having CSA certification to be used where readily available. Product to be certified to CSA standard(s) by an approved independent third party certification body accredited by the Standards Council of Canada and that is acceptable to the Contract Administrator. Products to be marked with certification body logo and CSA standard markings.
- .2 At least 2 weeks prior to commencing work, submit manufacturer's recent test data and certification that materials to be incorporated into works are representative and meet requirements of this Section. Include manufacturer's drawings where pertinent.

1.5 Shop Drawings and

- .1 Shop drawings and technical data are not required unless specified otherwise in Technical Data Supplementary Specifications.
- .2 Where specified, refer to General Conditions, Clause 5, Shop Drawings.

1.6 Record Drawings

- .1 Provide record drawings, including directions for operating valves, list

of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details, maintenance and operating instructions.

1.7 Scheduling of Work

- .1 Schedule work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions to Contract Administrator for approval and adhere to approved schedule.
- .3 Notify Contract Administrator, affected residences and businesses minimum of 24 h in advance of any interruption in service.
- .4 Do not interrupt water service for more than 3 h and confine this period between 09:00 and 16:00 h unless otherwise authorized.
- .5 Notify fire department of any planned or accidental interruption of water supply to hydrants.

1.8 Measurement and Payment

- .1 Refer to Section 02100, Measurement and Payment.

1.9 Inspection and Testing

- .1 Refer to General Conditions, Clause 4.12, Inspections.

2 PRODUCTS

2.1 General

- .1 Pipe material as shown on Contract Drawings, excluding main pipe within chambers which shall be steel, and leads to fire hydrants which shall be ductile iron or PVC.
- .2 All products are specified by reference to approved specifications and/or standards. Refer to Supplementary Specifications and/or Contract Drawings for specified or approved manufacturers or trade names.
- .3 All mainline pipe, joints and fittings regardless of material, will have a cast iron outside diameter.

2.2 Mainline Pipe, Joints and Fittings

- .1 Ductile iron pipe:
 - .1 Pipe: to AWWA C151, to Pressure Class or Special Thickness Class specified in Contract Documents, and standard cement mortar lined to AWWA C104/A21.4
 - .2 Joints: Single rubber gasket for push-on bell and spigot type joint and/or mechanical pipe joints: to AWWA C111 Tyton.

.2 Polyvinyl Chloride (PVC) Pressure Pipe:

.1 Pipe:

.1 Pipe to be manufactured to specifications for pipe size ranges as follows:

.1 Pipes 100 to 300mm dia. - AWWA C900

.2 Pipes 350 to 1200 mm dia. - AWWA C905

.3 AWWA C900 pipe to Pressure Class or AWWA C905 pipe to pressuring rating specified in Contract Documents.

.4 Pipes to be certified by Canadian Standards Association for pipe size ranges 100mm to 1200mm dia. - CSA B137.3.

.2 ULC listed.

.3 Cast iron pipe equivalent outside diameter.

.4 To be compatible with specified mechanical joint and push-on joint fittings and valves without use of special adapters.

.2 Joints: Push-on integrally thickened bell and spigot type to ASTM D3139 with single elastomeric gasket to ASTM F477.

.3 High Density Polyethylene Pipe:

.1 Pipe:

.1 To AWWA C906 pressure class specified in Contract Documents.

.2 Pipes to be certified by Canadian Standard Association CSA B137.1

.3 To be compatible with specified mechanical joint fittings and valves without special adapters.

.2 Joints: Heat butt-fusion to ASTM D2657 and in accordance with manufacturer's recommendations.

.3 Fittings:

.1 Fabricated HDPE mitred fittings to AWWA C906 suitable for pressure rating specified in Contract Documents.

.2 Moulded HDPE fittings to ASTM 3261 suitable for pressure rating specified and fusion to main pipe, dimensions as specified in Contract Documents.

- .3 Flanged joints to AWWA C906 flat faced stub end and loose hot-dip galvanized ductile iron (ASTM A536) backup ring drilling to ANSI B16.1, ANSI B16.5, or AWWA C207, class suitable for pressure rating specified in Contract Documents.
- .4 Nuts and bolts as specified for "Fittings" in this section.

.4 Fittings:

- .1 Gray-iron (cast iron) fittings to AWWA C110/A21.10-93 suitable for 1035 kPa minimum pressure rating or higher as specified in Contract Documents. Where specified in Contract Documents, to be cement mortar lined and externally seal coated, both to AWWA C104/A21.4.
- .2 Ductile iron fittings to AWWA C110 suitable for pressure rating of 2415 kPa, cement mortar lined to AWWA C104/A21.4.
- .3 Compact ductile iron fittings to AWWA C153/A21.53-94 suitable for pressure rating of 2415 kPa, cement mortar lined to AWWA C104/A21.4.
- .4 PVC injection-moulded fittings shall be DR18, conforming to AWWA C907 and certified to CSA B137.2 . PVC compound is 12454B according to ASTM D1784.
- .5 PVC fabricated fittings shall conform to either AWWA C900 or AWWA C905 and be certified to CSA B137.3. Fabricated fittings to be made from CSA certified PVC pipe of the same pressure class or pressure rating as the pipe.
- .6 Single rubber gasket for push-on bell and spigot type joint and/or mechanical pipe joints: to AWWA C111. All push-on joint hubs to be equipped with tie-rod lugs.
- .7 Flanged Joints:
 - .1 Flat faced conforming to the face dimension and drilling of ANSI B16.1, Class 125
 - .2 On AWWA C110 fittings to AWWA C110 with minimum pressure rating 1035 kPa or higher as specified in Contract Documents.
 - .3 On AWWA C153 fittings to AWWA C153 with minimum pressure rating of 1723 kPa or higher as specified in

Contract Documents.

- .8 Flange gaskets:
 - .1 Flange gaskets to be manufactured from black natural rubber 3.175 mm thick with layer of cotton on both sides.
 - .2 Gaskets to be nitrile or NBR.
- .9 Bolts and nuts:
 - .1 Bolts to be carbon steel, Grade B to ASTM A307, heavy hex style, zinc plated to ASTM B633 or cadmium plated to ASTM B766. Bolt sizes to AWWA C110. Nuts and washers:
 - .2 Nuts to be carbon steel, Grade A to ASTM A563. Washers to be flat hardened steel to ASTM F436. Nuts and washers to be zinc plated to ASTM B633 or cadmium plated to ASTM B766.
- .10 Tie Rods and Nuts:
 - .1 Tie rods to be continuous threaded, quenched and tempered alloyed steel to ASTM A354, Grade BC. To be zinc plated to ASTM B633 or cadmium plated to ASTM B766. Tie rod sizes to be minimum 19 mm diameter or greater as shown on Contract Drawings.
 - .2 Nuts and internally threaded couplings to be heavy hex finish to ASTM A563. Washers to be flat hardened steel to ASTM F436. All to be zinc plated to ASTM B633 or cadmium plated to ASTM B766.
- .11 Fabricated steel pipe fittings: to AWWA C208 and AWWA C207 if flanged, interior and exterior protected with hot applied coal tar enamel to AWWA C203 or liquid epoxy coating to AWWA C210.
- .12 Couplings and Flanged Coupling Adapters:
 - .1 General Requirements:
 - .1 Suitable for pressure class specified in Contract Documents.
 - .2 Flanges and full face flange gaskets where applicable to Clauses 2.2.4.7 and 2.2.4.8 of this Section.
 - .3 To AWWA C219
 - .4 Anti-corrosion coating of interior and exterior

centre sleeve and end rings to AWWA C219, AWWA C213, AWWA C210, or AWWA C550 as specified in Contract Documents.

- .5 Compression gaskets to AWWA C219.
- .6 Bolts and nuts high strength low alloy steel to AWWA C111, stainless steel to ASTM F593 or ASTM F738 for bolts and ASTM F594 or ASTM F836M for heavy hex nuts, as specified in Contract Documents. Rolled threads, fit and dimensions to AWWA C111.
- .7 Ductile iron castings to ASTM A536, Grade 65-45-12.
- .2 Plain end or transition couplings as specified in Contract Documents.
- .3 Flanged coupling adapters as specified in Contract Documents.
- .13 Joint Restraint Devices: General Requirements:
 - .1 Ductile iron castings to ASTM A536.
 - .2 Anti-corrosion coating of ductile iron castings to AWWA C219, AWWA C210, AWWA C213 or AWWA C550 as specified in Contract Documents.
 - .3 Bolts and nuts high strength low alloy steel to AWWA C111 or as specified in Contract Documents, stainless steel to ASTM F593 or ASTM F738 for bolts and ASTM F594 or ASTM F836M for heavy hex nuts. Rolled threads, fit and dimensions to AWWA C111.
 - .4 Tie rods to 2.2.3.8 of this Section.
 - .5 Restrainers for ductile iron pipe with mechanical joint fittings as specified in Contract Documents.
 - .6 Restrainers for PVC pipe to 2.2.2 of this Section with mechanical joint fittings as specified in Contract Documents.
 - .7 Restrainers for ductile iron pipe with push-on joint fittings with tie rod lugs as specified in Contract Documents.
 - .8 Restrainers for PVC to 2.2.2 of this Section with push-on joint fittings with tie rod lugs as specified in Contract Documents.

- .9 Restrained harnesses or integral restraint systems manufactures as part of the pipe joint as specified in Contract Documents.
- .10 Restrainers for bell joints in PVC pipe to 2.2.2 of this Section.
- .11 All joint restraint systems for PVC forcemain be approved by the PVC pipe manufacturer they are to be used on, and that they do not derate the pipe manufacturer's recommended working pressures.
- .14 Tapping sleeves for branch connections 75 mm and larger:
 - .1 General Requirements:
 - .1 Location, type and pressure class as specified in Contract Documents. (Exterior condition of existing water mains as found in the field may alter type and/or materials. Refer to General Conditions, Clause 11, Concealed or Unknown Conditions.)
 - .2 To AWWA C219 for sleeve and gasket materials and generally for design, manufacture and performance.
 - .3 Flanges and flange gaskets to 2.2.4.7 and 2.2.4.8 of this Section and AWWA C207 and AWWA C208 for fabricated carbon steel sleeves. Flange gaskets for use with epoxy coated flanges to be annular ribbed type.
 - .4 Anti-corrosion coating of fabricated carbon steel and ductile iron sleeve assemblies to AWWA C213 (Fusion-Bonded Epoxy) or shop coated to AWWA C219 if field applied dressings are specified in Contract Documents.
 - .5 Bolts and nuts high strength low alloy steel to AWWA C111 or as specified in Contract Documents, stainless steel to ASTM F593 or ASTM F738 for bolts and ASTM F594 or ASTM F836M for heavy hex nuts. Rolled threads, fit and dimensions to AWWA C111.
 - .6 Ductile iron castings to ASTM A536, grade 65-45-12.
 - .7 Flanged branches for welding to steel pipe mains to AWWA C207 and AWWA C208.

- .8 Branches shall include a threaded test plug 19 mm NPS minimum if tapping machine to be used does not have provision for pressure testing.
- .2 Tapping sleeves for cast iron, ductile iron, asbestos cement, PVC to AWWA C900, pre-stressed concrete pressure pipe or steel mains for taps other than size-on size:
 - .1 Split assembly to incorporate an annular gasket cemented or mechanically held in place on the branch end or split assembly incorporating ring seal and wrap around sleeve length gasket liner.
 - .2 Acceptable models: as specified in Contract Documents.
 - .3 Tapping sleeves for size on size taps on cast iron, ductile iron, asbestos cement, PVC to AWWA C900, pre-stressed concrete pressure pipe or steel:
 - .1 Split assembly incorporating ring seal and wrap around sleeve length gasket/liner.
 - .2 Acceptable models: as specified in Contract Documents.
 - .4 Tapping sleeves for size on size tap on ductile iron pipe and PVC to AWWA C900 only:
 - .1 Acceptable models: as specified in Contract Documents.
- .15 Repair clamps shall be constructed of 18-8 stainless steel passivated for corrosion resistance. Stainless steel components shall be Type 304 or 304L. All surfaces including weld areas shall be thoroughly cleaned of scale, grease or other contaminants. Welding must be performed in a controlled environment to prevent sensitization. Nuts and bolts shall be Type 304 18-8 stainless steel 5/8 X 11 NC rolled thread lubricated to prevent galling. Gasket shall be SBR (Buna) rubber per ASTM D2000.
- .5 Pre-stressed Concrete Pressure Pipe

- .1 Pipe to AWWA C300, AWWA C301 and AWWA C303
- .2 Joints: push-on bell and spigot joints complete with rubber gasket.
- .6 Steel Pipe:
 - .1 To AWWA C200 wall thickness as specified in Contract Documents electrically welded. Steel to ASTM A36.
 - .2 Steel pipe flanges to AWWA C207. Dimensions for fabricated steel water pipe fittings to AWWA C208.
 - .3 Finishes - exterior and interior: hot applied coal tar enamel to AWWA C203 or liquid epoxy coating to AWWA C210.

2.3 Valves and Valve Boxes

- .1 Mainline Valves - General Requirements:
 - .1 Valves to open counter-clockwise.
 - .2 All valves to have manufacturer's name, year of manufacture, size and working pressure on the bonnet or body.
 - .3 Valves 400 mm and larger to have by-pass sized to AWWA C500.
 - .4 Gate valves 400 mm and larger to have gear operators.
- .2 Mainline Gate valves:
 - .1 Locations of solid wedge or double disc valves and resilient-seated valves as shown on Contract Drawings.
 - .2 To AWWA C500: 75 to 300 mm to working pressure 1380 kPa; 400 mm and larger to working pressure 1035 kPa, gray cast iron or cast ductile iron body, bronze mounted solid wedge, or double disc, non-rising stem, hub or flanged ends.
 - .3 To AWWA C509: 75 to 300 mm to working pressure 1380 kPa; Gray cast iron or ductile iron body, resilient seated, non-rising stem, hub or flanged ends.
 - .4 Stem seal to be O-ring type.
 - .5 Hydrant valves - to be as specified for mainline gate valves.
 - .6 Valves to be complete with 50 mm square operating nut for underground service.

- .7 Acceptable manufacturers are as specified in Contract Documents.
- .3 Mainline butterfly valves: Butterfly valves: to AWWA C504 Class 150B, as specified in Contract Documents.
- .4 Blowdown or Blow-Off Valves: 50 mm to AWWA C800 for working pressure 1035 kPa threaded ends, 75 mm to 300 mm as specified for mainline gate valves.
- .5 Air Release, Air/Vacuum and Combination Air Valves:
 - .1 Gray cast iron or ductile iron body.
 - .2 Threaded or flanged connections.
 - .3 Maximum working pressure 2070 kPa.
 - .4 To AWWA C512.
- .6 Mainline Valve Boxes:
 - .1 To be as specified in Contract Documents: telescoping, cast iron, top flange type service box:
 - .1 Rectangular type to be as specified in Contract Documents.
 - .2 Circular type to be as specified in Contract Documents.
 - .2 Valve box riser pipe to be 150 mm diameter PVC DR 35 or better.
- .7 Service Valve Boxes:
 - .1 Curb stop valve boxes (300 mm from property line) on 25 mm diameter or smaller services to be telescoping assembly comprised of threaded cast iron top with bronze pentagon centre plug, 25 NPS iron pipe, cast iron base allowing threaded insertion of 25 NPS pipe and accommodation for curb stop valve (cast iron base section may thread onto curb stop valve) and 14 mm diameter steel operating rod attached to curb stop valve with bronze cotter pin, as specified in Contract Documents.
 - .2 Curb stop valve boxes (300 mm from property line) on 32 mm dia. to 50 mm dia. services to be assembly specified in 2.3.7.1 of this Section, except with 19 mm dia. steel operating rod, or as specified in Contract Documents.

2.4 Valve and Large Meter Chambers

- .3 Curb stop valve boxes (300 mm from property line) alternative on 19 mm dia. to 50 mm dia. services without operating rods to be assembled as specified in 2.3.6.1.2 and 2.3.6.2 of this Section.
- .4 Curb stop valve boxes (300 mm from property line) on services 75 mm dia. and larger as specified for Mainline Valve Boxes.
- .5 Corporation stop valve boxes (at mainline tees or tapplings) on services 75 mm dia. and larger as specified for Mainline Valve Boxes.
- .8 Check Valves:
 - .1 To AWWA C508: 50 to 300 mm to working pressure 1200 kPa; 400 to 500 mm to working pressure 1035 kPa; gray cast iron or ductile cast iron body, clear waterway type, metal to metal seat, mechanical joint ends to AWWA C111 or flanged ends to AWWA C110.
- .1 Applicability: for mainline butterfly valves or mainline gate valves 400 mm and larger and for meters 200 mm and larger.
- .2 As specified in Contract Documents, valve chambers for pressure reducing valves, meters and backflow prevention devices may have special and additional requirements and features.
- .3 Materials and installation for Cast-in-place chambers to Section 33 44 01 -Manholes and Catchbasins.
- .4 Concrete and reinforcing steel: to Section 03 20 01 - Concrete Reinforcement and Section 03 30 53 - Cast-in-Place Concrete.
- .5 Precast concrete sections to ASTM C478M. Ladder rungs be cast integral with unit; field installation not permitted. Precast concrete lids to H-20 loading conditions.
- .6 Jointing materials:
 - .1 Manufacturer's rubber ring gaskets,
 - .2 Mastic joint filler,
 - .3 Cement mortar or,

- .4 Combination of above types.
- .7 Mortar: aggregate to CAN/CSA-A82.56, masonry cement to CAN/CSA-A8.
- .8 Ladder rungs for valve chambers: minimum 20 mm diameter, for 76 mm minimum embedment in precast or cast-in-place concrete, minimum rung length 250 mm, minimum projection 100 mm, maximum vertical spacing 300 mm, minimum design live load 1334N, cold rolled steel to CAN/CSA-G40.20, hot-dip galvanized after fabrication to CAN/CSA-G164 or aluminum alloy #6061-T6 to CAN3-S157 and NBC 1990. Rungs to be safety pattern. Hand holds at top entry to conform to minimum design live load and dimensions.
- .9 Valve chamber frames and covers: as specified in Contract Documents.
- .10 Mechanical and Electrical: as specified in Contract Documents.

2.5 Service Connections, Pipe, Joints and Fittings

- .1 Pipe diameter 19 mm to 75 mm to be Polyethylene to AWWA C901, Pressure Class 160 tubing certified to CSA B137.1 or Type K annealed copper, to ASTM B88M or Polyethylene/Aluminum/Polyethylene composite pipe certified to CSA B137.9 or CSA B137.10
- .2 Pipe diameter 100 mm and larger to be of material specified for mainline pipe.
- .3 Service saddles:
 - .1 Tapping threads to be tapered to AWWA C800.
 - .2 Saddles for ductile iron pipe:
 - .1 Saddles for 19 to 50 mm services to have a ductile iron body to ASTM A536.
 - .2 Anti-corrosive coating to AWWA C219, AWWA C210, or AWWA C213, as specified in Contract Documents.
 - .3 Two high strength low alloy steel straps to AWWA C111, or Type 304 stainless steel U-bolt straps, with minimum width per strap of 50 mm, as specified in Contract Documents.

- .3 Saddles for PVC pipe to AWWA C900/AWWA C905:
 - .1 To provide full support around circumference of pipe; saddles with lugs or U-bolt straps that may gouge or deform the pipe are not allowed.
 - .2 Saddles for 19 to 50 mm services as specified in Contract Documents:
 - .1 Bronze body to ASTM B62 and two stainless steel straps to ANSI T304 with minimum width per strap of 50 mm.
 - .2 Ductile iron body to ASTM A536:
 - .1 Anti-corrosive coating to AWWA C219, AWWA C210, or AWWA C213, as specified in Contract Documents.
 - .2 Two high strength low alloy steel straps to AWWA C111, or Type 304 stainless steel U-bolt straps, with minimum width per strap of 50 mm, as specified in Contract Documents.
 - .3 All-stainless steel broadband saddle to ANSI T304; 19 and 25 mm services to have single bolt and minimum band width of 125 mm; 37 and 50 mm services to have double bolt and minimum width of 190 mm.
 - .4 For services 75 mm and larger use tapping sleeves to 2.2.4.14 of this Section.
 - .5 Copper tubing joints to be flared or compression type suitable for 1100 kPa working pressure.

2.6 Hydrants

- .1 Hydrants to: AWWA C502, standard specifications for dry barrel Fire Hydrants for ordinary waterworks service; typical fire hydrant detail drawing and B.C. Standard for Fire Hydrants with following supplementary details:
 - .1 Shut-Off: compression type or slide gate as per supplementary specifications or contract documents.
 - .2 Inlet Connection: to be 150 mm nominal diameter, bell type with harness lugs.
 - .3 Bury Length: nominal bury length as shown on Contract Drawings.
 - .4 Delivery Classification: two hose nozzles and one pump

nozzle. Each outlet nozzle to be locked or screwed in place to safeguard against blowing out, turning or backing out.

.5 Diameter:

.1 hose nozzles to be 65 mm nominal diameter.

.2 pump nozzles to be 100 mm nominal diameter.

.6 Hose and Pump Nozzle Threads:

.1 Hose nozzle to B.C. standard for Fire Hydrants (76.20 mm outside diameter and 8 threads per 25.4 mm)

.2 Pump nozzle to be 117.475 mm outside diameter and 6 threads per 25.4 mm.

.3 As an alternate pump nozzle may be specified in Municipal Supplementary Specifications as an alternate dimension thread ratio or a "quick connect" STORZ type.

.7 Nozzle Cap Gasket: to be provided with each nozzle cap.

.8 Opening Direction: counter-clockwise.

.9 Operating Nut and Cap Nuts: Pentagonal 3.75 mm point to flat. to B.C. Standard for fire hydrants.

.10 Working parts to be removable without disturbing barrel or base of hydrant and without excavation. Main operating stem to be non-rising. Hydrant to be so designed that its top section may, without excavation, be rotated at any angle relative to the inlet pipe if desired and bolted or locked in place without decreasing its strength or causing it to leak when under pressure.

.11 Hydrants to be subjected to hydrostatic pressure test of 2070 kPa in compliance with AWWA C502. Provide "Affidavit of Compliance" if requested by Contract Administrator.

.2 Colour: as specified in Contract Documents.

.3 Approved standard 150 mm Fire Hydrants are as specified in Documents or Municipal Supplementary Specifications.

2.7 Underground Service Line Valves and Fittings

.1 Underground service line valves and fittings 19 to 50 mm to AWWA C800 suitable for 1035 kPa working pressure.

.2 Corporation Stops:

- .1 19 to 50 mm: bronze to ASTM B62, AWWA thread inlet, compression type outlet.
- .2 To be as specified in Contract Documents.

.3 Curb Stops:

- .1 19 and 25 mm to be bronze to ASTM B62; inverted key, ball or cylinder type construction utilizing rubber O-ring seals.
 - .2 37 and 50 mm to be bronze to ASTM B62; ball or cylinder type construction utilizing rubber O-ring seals.
 - .3 To be full flow, full port, as specified in Contract Documents.
 - .4 Fittings: to be compression type for underground services.
 - .5 All fitting and valve connections on polyethylene to have solid fluted stiffening liners manufactured from stainless steel to ANSI T304 designed for the appropriate type and inside dimension of pipe, warranted by the manufacturer for that use.
- .4 Underground service line valves 75 mm and larger to 2.3.1 and 2.3.2 of this Section.

**2.8 Granular Pipe Bedding
and Surround Material**

- .1 As shown on Contract Drawings.
- .2 Refer to Section 02226 - Aggregates and Granular Materials for materials specifications.

2.9 Backfill Material

- .1 As shown on Contract Drawings.
- .2 Refer to Section 02226 - Aggregates and Granular Materials for material specifications.

3.0 EXECUTION

3.1 General

- .1 Pipe bedding details, including granular surround (pipe cushion) and material specifications to be as shown on Contract Drawings, including Standard Detail Drawing G4.

3.2 Preparation

- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of debris and water before installation. Carefully inspect materials for defects before installing. Remove defective materials from site.

3.3 Trenching

- .1 Do trenching in accordance with Section 02223 - Excavating, Trenching and Backfilling.
- .2 Trench alignment and depth as shown on Contract Drawings.
- .3 Trench depth to provide cover over pipe of not less than 1.0 m from finished grade unless shown otherwise on Contract Drawings.

3.4 Concrete Bedding and Encasement

- .1 Do concrete work in accordance with Section 03300 - Cast-in-Place Concrete. Place concrete to details as shown on Contract Drawings.
- .2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .3 Do not backfill over concrete within 24 h after placing.

3.5 Granular Bedding

- .1 Fill over-excavation below design elevation of bottom of specified bedding with granular bedding placed and compacted in accordance with 3.5.2 and 3.5.5 of this Section. Drain rock may be used for backfill of over-excavation only with Contract Administrator's approval.
- .2 Place granular bedding material across full width of trench bottom in uniform layers to depth shown on Standard Detail Drawings.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe. Do not use blocks when bedding pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to minimum 95% Modified Proctor Density in compliance with ASTM D1557. (All following references to density imply in compliance with ASTM D1557).
- .6 Place watermain pipe and water service tubing on prepared flat bottomed trench free of rock in excess of 50 mm without bedding and backfill with approved native or imported material and compact as specified. Use hand tools to compact material under 'haunch' area of pipe and around fittings and other materials.
- .7 Use imported bedding material when native material is deemed

unsuitable for backfill by Contract Administrator or when trench has been excavated in rock.

- .8 Use imported bedding material when using pipe materials other than ductile iron or copper.
- .9 Use imported bedding when proposed work is installed through paved areas, when native material is deemed unsuitable for backfill by Contract Administrator or when trench has been excavated in rock.

3.6 Pipe Installation

- .1 Handle pipe in accordance with pipe manufacturer's recommendations. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .2 Lay and join pipes to manufacturer's instructions and specifications except as noted otherwise herein. PVC pipe to AWWA M23 and AWWA C605; ductile iron pipe to AWWA C600.
- .3 Horizontal tolerance: plus or minus 50 mm from specified alignment. Vertical tolerance: plus or minus 25 mm from specified grade.
- .4 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .5 Face socket ends of pipe in direction of laying. For mains on a grade of 2% or greater, face socket ends up-grade.
- .6 Do not exceed maximum joint deflection recommended by pipe manufacturer. Refer to AWWA C600 for ductile iron pipe; and AWWA C605 for PVC pipe. For PVC pipe deflections exceeding manufacturer's recommendation, use:
 - .1 PVC High Deflection coupling rated at 1380kPa (100mm-300mm)
 - .2 PVC long radius 5 degree bend rated at 1620kPa (100mm-750mm)
- .7 Keep jointing materials and installed pipe free of dirt, water and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of water and foreign materials.
- .8 Position and join pipes with equipment and methods specified in 3.6.2 of this Section.

- .9 Cut pipes as required, as recommended by pipe manufacturer, without damaging pipe or its coating and leave smooth end at right angles to axis of pipe.
- .10 Joints:
 - .1 Install gaskets as recommended by manufacturer.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes carefully before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
 - .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.
 - .6 Complete each joint before laying next length of pipe.
 - .7 Minimize joint deflection after joint has been made to avoid joint damage.
 - .8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
 - .9 For ductile iron pipe do not install bronze wedges or other conductivity devices unless specified in Contract Documents.
 - .10 Butt-fuse high density polyethylene in strict accordance with manufacturer's instruction by manufacturer or by manufacturer trained personnel.
- .11 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as specified otherwise.
- .12 When any stoppage of work occurs, restrain pipes in an approved manner to prevent "creep" during down time.
- .13 Recheck components assembled above ground after placing in trench to ensure that no movement of joints has taken place.
- .14 Test and/or bleed points consisting of Corporation cocks, sized

to achieve minimum flushing velocities of 0.8 m/s in accordance with AWWA C651, to be provided where shown on Contract Drawings or as required by Contractor for pressure testing and flushing.

3.7 Valve Installation

- .1 Install valves to manufacturer's recommendations at locations shown on Contract Drawings.
- .2 Support valves located in valve boxes by means of either concrete or pressure treated and end treated wood blocks, located between valve and solid ground. Maximum length of pipe on each end of valve to be 1 m. Valves not to be supported by pipe.
- .3 Support valves located in valve chambers by means of either concrete blocks or fabricated steel pipe stands as shown on Contract Drawings.
- .4 Valves to be installed in vertical position with actuating stem plumb.

3.8 Valve Chambers

- .1 Use cast-in-place or precast units as shown on Contract Drawings. Precast units to be in accordance with Section 03400 – PreCast Concrete. Cast-in-Place units to be in accordance with Section 03200 - Concrete Reinforcement and Section 03300 - Cast-in-Place Concrete.
- .2 Construct units as shown on Contract Drawings, plumb and with valve chamber openings centred over valve nut, true to alignment and grade. Valve chambers not to rest on pipe.
- .3 Place reinforcing steel and miscellaneous metals required to be embedded in concrete to details shown on Contract Drawings and in accordance with Section 03300 - Cast-in-Place Concrete.
- .4 Cast bottom slabs for precast units directly on undisturbed ground where shown on Contract Drawings, set precast concrete slab on 100 mm minimum of compacted granular material.
- .5 Set bottom section of precast unit in bed of cement mortar and bond to bottom slab. Make each successive joint watertight with approved rubber ring gaskets, mastic joint filler, cement mortar, or combination thereof.
- .6 Clean surplus mortar and joint compounds from interior surface of valve chamber as work progresses.

- .7 Plug lifting holes with precast concrete plugs set in non-shrink non-staining grout or non-shrink, non-staining mortar.
- .8 Set frame and cover to required elevation on at least two and not more than four courses of brick or precast concrete riser rings. Make brick or riser ring joints and join brick or riser rings to frame with cement mortar, parge and trowel smooth.
- .9 Cover to be marked as specified in Contract Documents.
- .10 Clean valve chambers of debris and foreign materials; remove fins and sharp projections.
- .11 Set valve boxes centrally over valve nut. Set valve boxes and any other boxes around appurtenances and complete backfill within 24 h of setting appurtenance.
- .12 Install sump drainer assemblies to manufacturer's instructions and to AWWA C510 and AWWA C511.

3.9 Under-crossing

- .1 Excavate working pit to dimensions shown on Contract Drawings, outside right-of-way to be crossed.
- .2 Excavate working pit to not less than 0.6 m below lowest invert of encasing pipe.
- .3 Dewater excavation.
- .4 Dewater area of under-crossing.
- .5 Install heavy timber or steel frame backstop.
- .6 Place encasing pipe to exact line and grade shown on Contract Drawings. Encasing pipe to cross under obstruction at angle shown on Contract Drawings.
- .7 Install encasing pipe by jacking, boring or tunnelling methods approved by Contract Administrator.
- .8 Encasing pipe not to be in tension.
- .9 Joints for encasing pipe to be welded to AWWA C206.
- .10 Submit shop drawings showing proposed method of installation of carrier pipe.
- .11 For ductile iron carrier pipe only, install continuous zinc strip sacrificial anode electrically bonded to carrier pipe shown on Contract Drawings. Install sacrificial anodes for encasing pipe per Section 02642 – Cathodic Protection.

- .12 Insert carrier pipe into encasing pipe, in end with largest open area, after placing levelling pad.
- .13 Use approved chromated copper arsenate salt treated blocking method or fabricated high density polyethylene casing spacers to maintain carrier pipe in true alignment and uniform separation from encasing pipe.
- .14 Clearance between blocks or casing spacers and encasing pipe to be maximum 15 mm when carrier pipe is in position.
- .15 Join carrier pipe one length at a time outside encasing pipe. Push or pull carrier pipe into position.
- .16 Couplings of carrier pipe not to rest on levelling pad when carrier pipe is in position.
- .17 Place 20 MPa concrete cradle around carrier pipe after it is positioned. Cradle to be minimum of 225 mm and maximum of 300 mm above levelling pad.
- .18 Fill open annular space at each end of encasing pipe with burlap bags filled with 20 MPa concrete.

3.10 Service Connection Installation

- .1 Install service connections to 3.6 of this Section and as shown on Standard Detail Drawings as directed by Contract Drawings or Contract Administrator.
- .2 Construct service connections at right angles to watermain unless otherwise directed. Locate curb stops as shown on Contract Drawings.
- .3 Complete service connections before pressure testing of water main.
- .4 Tappings in cast iron or ductile iron mains 200 mm or greater in diameter may be threaded without service clamps provided specified pipe wall thickness is sufficient to conform to ANSI/ASME B1.20.1 for at least 3 threads as shown in Appendix A to AWWA C151.
- .5 Tappings in cast iron or ductile iron mains smaller in diameter than 200 mm; or cast iron or ductile iron mains with wall thickness which will not allow at least 3 full threads; or tap sizes beyond those shown in the following table are to be made using double strap saddles to 2.5.3 of this Section or tapping sleeves to 2.2.14 of this Section.

Pipe Size (mm)	Maximum	
	Tap Without Clamp (mm)	Maximum Tap With Clamp (mm)
100	19	25
150	25	32
200	25	50
250	25	50
300	32	75

- .6 Tappings in PVC mains to AWWA C900/AWWA C905 pipe to be with service saddles specified in 2.5.3.3 of this Section. Nuts on service saddle straps to be tightened to torque range specified by manufacturer and in no case in excess of that torque. Use core-out type bit, provide coupons to Contract Administrator.
- .7 Tap main as shown on Standard Detail Drawings W2a and W2b, not closer to a joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m, whichever is greater. No two adjacent connections on same pipe length to be on same plane of pipe.
- .8 Leave corporation stop valves fully open.
- .9 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .10 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
- .11 Install curb stop with curb stop valve box on services 50 mm or less in diameter. Equip larger services with a gate valve and cast iron valve box. Set box plumb over stop or valve and adjust top flush with final grade elevation. Leave curb stop or service valves fully closed.
- .12 Place temporary location marker at ends of plugged or capped unconnected water lines. Each marker to consist of 40 x 90 mm stake extending from pipe end at pipe level to 500 mm above grade. Mark and paint blue exposed portion of stake with designation "WATER".

3.11 Tapping Sleeve Installation

- .1 Thoroughly clean the exterior of the main to be tapped. Grind or file any protrusions or irregularities in the pipe exterior which may interfere with uniform seating of gaskets or clamping bands. In accordance with Section 10 of AWWA C651, dust

interior surface of the tapping sleeve annulus with calcium hypochlorite powder before attaching to the main.

3.12 Hydrants

- .1 Install hydrant assemblies at locations shown on Contract Drawings.
- .2 Install hydrant assemblies in accordance with AWWA M17 and in accordance with Standard Detail Drawing W4.
- .3 Set hydrants plumb, with hose nozzles parallel with edge of pavement or curb line, with pumper nozzle facing roadway at right angles to road centreline and with body flange set at elevation of 50 to 150 mm above final grade.
- .4 Place concrete thrust blocks as shown and as specified ensuring that drain holes are unobstructed.
- .5 To provide proper draining for each hydrant, excavate a pit as shown and backfill with coarse gravel or crushed stone to a level 150 mm above drain holes.
- .6 For hydrants not in service, place an orange painted sign, 30 cm x 30 cm , lettered "Not In Service" on the main port. Remove when water main is accepted by the Contract Administrator.

3.13 Thrust Blocks

- .1 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as shown on Contract Drawings or as directed by Contract Administrator and as detailed on Standard Detail Drawing W1.
- .2 Place 6 mil polyethylene between interface of concrete and fitting.
- .3 Where shown in Contract Documents, joint restraint devices to 2.2.13 of this Section.
- .4 Do concrete work in accordance with Section 03300 Concrete - Cast-in-Place
- .5 Keep joints and couplings free of concrete.
- .6 Do not backfill over concrete within 24 h after placing.

3.14 Corrosion Protection

- .1 Where specified, provide corrosion protection measures per Section 2642 – Cathodic Protection.

3.15 Pipe Surround

- .1 Upon completion of pipe laying and after Contract Administrator has inspected work in place, surround and cover pipes as shown on Standard Detail Drawing G4.
- .2 Hand place surround material in uniform layers simultaneously on both sides of pipe. Do not dump material within 1 m of exposed pipe.
- .3 Compact each layer from pipe invert to underside of backfill to minimum 95% Modified Proctor Density.
- .4 Install concrete encasement where shown on Contract Drawings or as directed by Contract Administrator. For PVC mainline or service pipe install high deflection PVC coupling 0.3 m minimum to 0.5 m maximum from end of encasement. For ductile iron mainline or service pipe ensure hub joint occurs 0.3 m minimum to 0.5 m maximum from end of encasement.

3.16 Backfill

- .1 Place and compact backfill material in accordance with Section 02223 - Excavating, Trenching and Backfilling.
- .2 Backfill requirements, including type of material and compaction requirements as shown on Contract Drawings, including Standard Detail Drawing G4.

3.17 General Procedure Flushing, Testing, and Disinfection

- .1 All cleaning, flushing, pressure and leakage testing, disinfection and final flushing to be done by Contractor. Costs are included in pay items described in 1.8 of this Section.
- .2 Perform all tests in presence of Contract Administrator. Notify Contract Administrator 24 h in advance of proposed test.
- .3 Where any section of system is provided with concrete thrust blocks, do not conduct tests until at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- .4 Obtain municipal approval prior to discharging flushing water to municipal sewers or drainage ditches.
- .5 Comply with General Conditions, Clause 20.4, Environmental Laws, in regard to discharge of flushing water.
- .6 Provide Contract Administrator with all required approvals prior to discharging flushing water.

3.18 Cleaning and Preliminary Flushing

- .1 Before flushing and pressure testing, ensure waterworks system is completely finished except tie-ins to existing watermains and make arrangements with Contract Administrator for scheduling of testing and disinfection of mains. Testing and disinfection to be witnessed by Contract Administrator.
- .2 Isolation of existing water system where required will be performed by Municipality. Do not operate any existing valves without Contract Administrator's authorization.
- .3 Water may be supplied from municipal fire hydrants upon application for a Hydrant Use Permit and presentation of valid test certificate for reduced pressure principle backflow prevention device conforming to AWWA C511.
- .4 Remove foreign material from pipe and related appurtenances by flushing with water. Main to be flushed at water velocities as high as can be obtained from available water sources. Minimum velocity to be 0.8 m/s and/or in accordance with AWWA C651. Continue flushing at least until flow from most distant point has reached discharge point and until water discharged is clean and clear.

3.19 Testing Procedure

- .1 Upon completion of construction of any section, which shall be defined as that pipeline and appurtenances located between any two adjacent line valves, make section ready for testing. Carry out testing in accordance with 3.19.2 of this Section.
- .2 Before pipe is filled with water, pipe bedding, concreting of all valves and fittings and backfilling to be completed as required in this specification. Fill each section of pipe and allow to remain full of water for a period of at least 24 hours prior to commencement of any pressure tests. Submit pipeline to a test of 1.5 x working pressure applied at highest elevation in each section, with a minimum of 1380 kPa applied at lowest point of test section. Ensure that test pressure does not exceed pipe or thrust restraint design pressures. Maximum allowable leakage rate at test pressure to not exceed 1.25 litres per millimetre diameter of pipe per kilometre per 24 hour period. Minimum duration of test period to be 2 hours. Maximum test pressures should not exceed those specified in CSA B137.3 - Table 9
- .3 Perform pressure and leakage testing of ductile iron piping to AWWA C600 and AWWA M41.
- .4 Perform pressure and leakage testing of polyvinyl chloride

(PVC) piping to AWWA M23 and AWWA C605.

- .5 Perform testing of welded steel piping to AWWA C206; no leakage allowed.
- .6 Should any test disclose excessive leakage, repair or replace defect and retest section until specified testing requirement is achieved.

3.20 Disinfection, General

- .1 After Contract Administrator has certified that pipes and appurtenances have passed all specified tests, flush and disinfect pipes and appurtenances.
- .2 Disinfect and flush in accordance with 3.21 of this Section.

3.21 Disinfection and Flushing Procedures

- .1 Do not use granular hypochlorite for disinfection of PVC pipe with solvent welded joints, as there is an explosive reaction potential.
- .2 Retain water containing not less than 25 mg/L free chlorine in water system for a period of at least 24 h, in accordance with AWWA C651, Continuous Feed Method. Submit outline of proposed disinfection procedure accompanied by marked up schematic drawing to Contract Administrator for approval 48 h in advance of commencement of disinfection.
- .3 Allow water from existing distribution system, isolated by reduced pressure principle backflow prevention device or other approved source of supply, to flow at constant, measured rate into newly laid watermain. In absence of a meter, rate may be approximated by methods such as placing Pitot gauge in discharge, measuring time to fill container of known volume, or measuring trajectory of discharge and using formula presented in AWWA C651.
- .4 At a point not more than 3 m downstream from beginning of new main, ensure water entering new main receives dose of chlorine fed at constant rate such that water will have not less than 25 mg/L free chlorine. To assure that this concentration is provided, measure chlorine concentration at regular intervals as specified in AWWA C651.
- .5 Amount of chlorine required to produce 25 mg/L concentration in 30 m of pipe of various sizes is given in following table:

Pipe Size (mm)	100 Percent Chlorine (kg)	1 Percent Chlorine Solution (Litres)
100	0.006	0.61
150	0.014	1.36
200	0.024	2.46
250	0.039	3.86
300	0.054	5.45
400	0.098	9.85

- .6 Allow flow of water containing chlorine to continue until entire main, all service connections, extremities and hydrants to be treated are filled with 25 mg/L chlorine solution. To ensure that this concentration has been attained throughout, measure free chlorine residual at a number of points and extremities along main. Retain chlorinated water in main for at least 24 h. During this time operate all valves, curb stops and hydrants in section treated in order to disinfect them thoroughly.
- .7 At end of this 24 h period, treated water to contain no less than 10 mg/L free chlorine throughout main. If chlorine content is less than 10 mg/L repeat chlorination procedure until specifications are met.
- .8 After completion of chlorination, flush chlorinated water from system, hydrants and services until chlorine concentration in remaining water is less than 0.3 mg/L chlorine residual.
- .9 Upon completion of disinfection and flushing, Contractor to remove test and bleed point apparatus and backfill and complete any other work required for placing of waterworks system in service.

3.22 Servicing Fire Hydrants

- .1 Immediately following completion, all hydrants installed as part of the project will be serviced by Municipality. All repair costs (parts and labour) to remedy defective parts or installation will be charged to Contractor.

3.23 Connections to Existing Mains

- .1 Connections to existing waterworks systems will normally be made by the Waterworks owner; or at the direction of the Contract Administrator by the Contractor. Make all necessary arrangements with Contract Administrator to schedule work to prevent construction delays.

1.0 GENERAL

- .1 Section 02921 refers to those portions of the work that are unique to the supply and placement of growing medium (topsoil) and subsequent finish grading. In this Section, the term “growing medium” is used in place of the generic and commonly used term “topsoil”. The term “topsoil” in this Section is used where appropriate to identify imported or on-site natural material conforming to 2.4 – Imported Topsoil. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 This section is based on the “British Columbia Landscape Standard” published by the B.C. Society of Landscape Architects and the B.C. Nursery Trades Association. This standard is intended to set a level of quality which is to be equalled or bettered in the construction documents for each project. Guidance of a registered British Columbia Landscape Architect is recommended.
- .3 This section is included for reinstatement work

1.1 Related Work

- | | |
|--|---------------|
| .1 Landscape Grading | Section 02211 |
| .2 Seeding | Section 02933 |
| .3 Hydraulic Seeding | Section 02934 |
| .4 Sodding | Section 02938 |
| .5 Planting of Trees, Shrubs, and
Ground Covers | Section 02950 |

1.2 References

- .1 British Columbia Landscape Standard.
- .2 Canadian System of Soil Classification.

1.3 Source Quality Control

- .1 Advise Contract Administrator of sources of growing medium to be utilized 7 days in advance of starting work.
- .2 Contractor is responsible for soil analysis and requirements for amendments to supply growing medium as specified.

**1.4 Measurement and
Payment**

- .1 Refer to Section 02100, Measurement and Payment.

**1.5 Inspection and
Testing**

- .1 Refer to General Conditions, Clause 4.12, Inspections.

2.0 PRODUCTS

2.1 General

- .1 In this Section, a range of measureable physical and chemical properties are set out as being acceptable in a growing medium. Compliance with this Section is to be determined by testing for those properties. When imported or on-site soil is used, it is to be tested and modified as necessary by admixture of other components to bring its properties within ranges set in 2.10 for growing medium.

2.2 Applications

- .1 Three different growing medium types are described in this Section for different applications:
 - .1 Low traffic lawn areas, trees, and large shrubs.
 - .2 High traffic lawn areas, having regular pedestrian traffic. This growing medium has relatively high structural strength but will require more care due to lower water and nutrient capacity.
 - .3 Growing medium for planting areas, such as for shrub and ground cover areas and in planters. This growing is similar to that for low traffic lawn areas, but has higher organic content and slightly lower pH. This may be achieved by adding peat moss to growing medium for low traffic lawn areas.

2.3 Native Topsoil

- .1 On-site native topsoil may be used, provided it meets standard set for imported topsoil and can be modified to meet requirements set out for specified growing medium.
- .2 If testing shows on-site soil to be suitable for landscaping, a sufficient quantity of stripped topsoil to be stockpiled where shown on Contract Drawings or in areas specified for stockpiling.
- .3 Do not handle topsoil while in a wet or frozen condition or in any manner in which structure is adversely affected.

2.4 Imported Topsoil

- .1 Imported topsoil to be friable loam, neither heavy clay nor of very light sandy nature, containing a minimum of 4% organic matter for clay loams and 2% for sand loams, to a maximum of 20% by volume. To be free from subsoil, roots, noxious grass, weeds, toxic materials, stones over 30mm, foreign objects, and with an acidity range (pH) of 5.5 to 7.5. To be free from crabgrass, couchgrass, equisetum, or noxious weeds or seeds or parts thereof.
- .2 Freedom from rock or debris to be such that 95 – 100% of particles pass a 25mm sieve and 85 - 100% pass a 9.5mm sieve.
- .3 Population of any single species of plant pathogenic nematode to not exceed 1000 per litre of growing medium.

2.5 Peat Moss

- .1 Peat moss to be Horticultural grade, partially decomposed fibrous or cellular stems and leaves of Sphagnum Mosses with texture varying from porous to spongy fibrous, fairly elastic and substantially homogeneous with pH value not less than 3.5 and not greater than 4.5, free of decomposed colloidal residue, wood, sulphur, and iron, brown in color and medium to coarse shredded, suitable for horticultural purposes.
- .2 Salinity: saturation extract conductivity to not exceed 2.0 millimhos/cm at 25 ° C.
- .3 Organic content: to be no less than 90% based on dry weight as determined by ash analysis.
- .4 Nitrogen: to be no less than 0.8% based on dry weight.
- .5 Particle size: 95 – 100% passing a 9.5mm sieve.
 0 – 15% passing a 0.500mm sieve.

2.6 Sand

- .1 Sand to be hard, granular sharp sand to CSA A82.50, well washed and free of impurities, chemical or organic matter.
- .2 Particle size in sand to be:
 - .1 95 – 100% passing a 4.75mm sieve.

- .2 0 – 40% passing a 0.500mm sieve.
- .3 0 – 5% passing a 0.050mm sieve.

2.7 Manure

- .1 Manure to be well-rotted farm animal manure, rotted to extent that liquids have been eliminated, and material is crumbly, free from weed seeds, rocks, sticks, rubble and containing not more than 40% sawdust, straw, or shavings.
- .2 Manure to be free of harmful chemicals such as any used to artificially hasten decomposition, and to have salt content that gives an electrical conductivity reading of less than 0.5mmho/cm.
- .3 Manure to contain not less than 1.0% nitrogen based on dry weight.
- .4 All particles in manure to pass a 6.35mm sieve.
- .5 Manure to be free of viable seed, maximum two plants per litre of manure.

2.8 Wood Residuals

- .1 Where wood residuals such as fir or hemlock sawdust are present in growing medium, their quantities and properties to be such that total Carbon to total Nitrogen ratio is a maximum of 40:1.
- .2 Cedar or redwood sawdust to not be present in growing medium.

2.9 Fertilizers

- .1 Chemical Fertilizers:
 - .1 Fertilizers to be standard commercial brands, meeting requirements of Canada Fertilizer Act.
 - .2 All fertilizers to be in granular, pelleted or prill form and to be dry. Free flowing and free from lumps.
 - .3 Fertilizers to have a guaranteed N-P-K analysis.
 - .4 Fertilizers to be packed in standard waterproof containers, clearly marked with name of manufacturer.
 - .5 Fertilizers to be stored in weatherproof storage place and in such a manner that it will stay dry and its effectiveness is not impaired.

- .6 Fertilizers to include, but not limited to those shown in Table 1.

TABLE 1: Fertilizer

Name	Minimum Proportion by Weight	Main Element
Ammonium Nitrate	33.5%	N
Ammonium Sulfate	21.0%	N
Superphosphate (0-20-0)	8.5%	P (20% P2O2)
Superphosphate (0-45-0)	19.5%	P (20% P2O2)
Potassium Sulfate	41.5%	K (50% K2O)
Potassium Chloride (muriate)	50.0%	K (60% K2O)
Potassium nitrate	13.0%	N
	36.5%	K (44% K2O)
Iron Sulfate	20.0%	Fe, as metallic
Gypsum	23.0%	Ca
Rock, Oyster shell lime, limestone flour	40.0%	Ca
Dolomite Lime	20.0%	Ca
	13.0%	M
Bonemeal	20.0%	Phosphoric Acid
	3.0%	N

(Bonemeal, Gypsum and limes to be finely ground, to 12 mesh or finer)

2.10 Growing Medium

- .1 Growing medium is any soil, soil substitute, or mixture whose chemical and physical properties fall within ranges required by this Section for a particular application.
- .2 Growing medium to be free of plants or their roots, sticks, building materials, wood chips (in excess of 10 mm in maximum dimensions), chemical pollutants, and other extraneous materials not contributing to generally desirable physical and chemical properties for landscaping purposes.
- .3 Growing medium to require not more than 0.5 kg/m² of dolomite lime to reach required pH level.
- .4 Fertility (nitrogen, phosphorous and potassium) and pH: may be modified after growing medium is placed, by

incorporation of lime and fertilizers, or by incorporating these chemicals when mixing and screening.

- .5 Salinity: saturation extract conductivity to not exceed 3.0 millimhos/cm at 25°C.
- .6 Boron: concentration in saturation extract to not exceed 1.0 ppm.
- .7 Sodium: sodium adsorption ratio (SAR) as calculated from analysis of saturation extract do not exceed 8.0.
- .8 Total Nitrogen: to be 0.2% to 0.4% by weight.
- .9 Available Phosphorous: to be 50 to 70 ppm.
- .10 Available Potassium: to be 50 to 100 ppm.
- .11 Cation Exchange Capacity: to be 30 to 50 meq.
- .12 Carbon to Nitrogen Ratio: to be not more than 40:1.
- .13 Acidity: to be within pH range shown in Table 2 for intended application.
- .14 Texture: particle sizes and proportions of each size particle to be within ranges shown in Table 2 for intended application.
- .15 Organic Content: to be within range shown in table 2 for intended application.
- .16 Drainage of growing medium can be measure only after growing medium in place. Mixing and handling or growing medium to be done in such a manner that minimum saturated hydraulic conductivity shown in Table 2 is achieved.
- .17 Tolerances: samples of growing medium taken just before planting to have above properties to within tolerances of $\pm 20\%$, except for salinity, which is to be less than stated limit.

TABLE 2: Properties of Growing Medium for Different Applications

Properties	Low Traffic Lawn Areas, Trees and Large Shrubs	High Traffic Lawn Areas	Planting Areas, Planters, Shrub and Groundcover Areas
TEXTURE: Particle size classes by Canadian System of Soil Classification	Percent of Dry Weight Mineral Fraction (%)		
Gravel - greater than 2 mm less than 75 mm	0-10	0	0
Sand - greater than 2 mm less than 2 mm	50-70	80-90	50-70
Silt - greater than 0.002 mm less than 0.05 mm	10-30	5-20	10-30
Clay - less than 0.002 mm	7-20	2-5	7-20
ACIDITY (pH)	6.0-6.5	6.0-6.5	5.0-6.0
DRAINAGE: Minimum saturated hydraulic conductivity (cm/hr) in place	2.0	7.0	2.0
ORGANIC CONTENT: Percent of Dry Weight (%)	5-10	3-5	25-30

3.0 EXECUTION

3.1 Stripping of Topsoil

- .1 Strip existing topsoil in accordance with Section 02210 – Site Grading.

3.2 Preparation of Subgrade

- .2 Verify that grades are correct. If discrepancies occur, notify Contract Administrator and do not commence work until instructed by Contract Administrator.

- .3 Grade soil. Eliminating uneven areas and low spots, ensuring positive drainage.
- .4 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 75 mm above surface. Dispose of removed material to approved off-site disposal area.
- .5 Coarse cultivate entire area which is to receive growing medium to minimum depth of 150 mm immediately before placing growing medium. Cross cultivate areas where equipment used for hauling and spreading has compacted soil.

3.3 Processing Growing Medium

- .1 Ensure commercial processing and mixing of growing medium components are done thoroughly by mechanized screening process. Do not mix by hand. Ensure resulting product is homogenous mixture having required properties throughout.
- .2 Ensure moisture content of peat moss at time of mixing not less than 50% to 100 %. Peat moss to form a ball when squeezed and retain shape upon release of pressure. Insufficient moisture will result in peat moss not holding together while excessive moisture is evident when ball formed is pliable with clear water sheen on surface.
- .3 Do not prepare or handle growing medium in a wet or frozen condition.

3.4 Placing Growing Medium

- .1 When subgrade accepted by Contract Administrator commence placing growing medium.
- .2 Place growing medium over prepared subgrade and allow to settle or compact by light rolling such that it is firm more than necessary to meet this requirement.

- .3 Ensure growing medium is moist (25% to 75% of field capacity) but not wet when placed, and do not handle if frozen or so wet that its structure will be altered.
- .4 Manually spread growing medium around trees, shrubs and obstacles.
- .5 Table 3 sets out minimum depths of growing medium after settlement for various types of subgrade.

Table 3: Minimum Growing Medium Depths

	Minimum Depths	
	Over Prepared Soil	Over Structures
	Where subsoil has medium (loamy) texture	Where subsoil has coarse (sandy) or fine (clay) texture
Application		

Low traffic lawn areas:			
i) irrigated	100 mm	150 mm	150 mm
ii) not irrigated	100 mm	150 mm	225 mm
High traffic lawn areas:			
	100 mm	150 mm	
Planting medium:			
i) ground cover areas	150 mm 300 mm	300 mm 450 mm	225 mm 300-500 mm
ii) shrub areas - small shrubs	450 mm 225 mm on	600 mm 300 mm	500-900 mm
iii) shrub areas - large shrubs	sides and bottom of	sides and bottom of	See Section 02950
iv) tree pits	rootball	rootball	

- 3.5 Applying Fertilizers**
- .1 Add fertilizers to bring growing medium fertility within ranges set out in this Section.
 - .2 Add lime (if required) and potassium (if required) to growing medium at time of screening. Add all other fertilizers (such as nitrogen, phosphorous and micronutrients) to growing medium by thorough cultivation after medium is in place (if required).
 - .3 Spread fertilizers evenly over growing medium with suitable mechanical spreader.
 - .4 Ensure fertilizers are fully incorporated to minimum depth of 150 mm, except in lawn areas, where they are to be incorporated to depth of 50 mm.
 - .5 minimum one week separation between application of lime and fertilizers other than lime.
- 3.6 Finished Grading**
- .1 Fine grades growing medium after placing to specified elevations and contours. Re-grade rough spots and low areas to ensure positive surface drainage.
 - .2 Finish surface smooth, uniform, firm against deep foot printing with a fine loose surface texture.
- 3.7 Acceptance**
- .1 Contract Administrator will inspect and test growing medium in place and determine acceptance of material, depth of growing medium and finish grading. Approval

of growing medium material subject to soil testing and analysis.

**3.8 Restoration
Of Stockpile
Sites**

- .1 Restore stockpile sites as specified in Contract Documents.

3.9 Clean-up

- .1 Dispose of surplus materials and all construction debris offsite.

1.0 GENERAL

- .1 Section 02933 refers to those portions of the work that are unique to the supply and application of grass seed by mechanical dry seeding or hand seeding. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 This section is based on the “British Columbia Landscape Standard” published by the B.C. Society of Landscape Architects and the B.C. Nursery Trades Association. This standard is intended to set a level of quality which is to be equalled or bettered in the construction documents for each project. Guidance of a registered British Columbia Landscape Architect is recommended.
- .3 This section is included for reinstatement work.

1.1 Related Work

- | | |
|--|---------------|
| .1 Landscape Grading | Section 02211 |
| .2 Topsoil and Finish Grading | Section 02921 |
| .2 Seeding | Section 02933 |
| .3 Hydraulic Seeding | Section 02934 |
| .4 Sodding | Section 02938 |
| .5 Planting of Trees, Shrubs, and
Ground Covers | Section 02950 |

1.2 References

- .1 British Columbia Landscape Standard.
- .2 Canadian System of Soil Classification.

1.3 Scheduling

- .1 Schedule all operations to ensure optimum environmental protection, grading, growing medium placement, planting, seeding or sodding operations as outlined in these Specifications. Organize scheduling to ensure a minimum duration of on-site storage of plant material, minimum movement and compaction of growing medium, and prompt mulching and watering operations. Coordinate work schedule with scheduling of other trades on-site.

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- | | | |
|------------------------------------|----|--|
| | .2 | Coordinate and schedule such that no damage occurs to materials before or after placement. In particular, requirements of living plant material to be met Contractor is responsible for soil analysis and requirements for amendments to supply growing medium as specified. |
| | .3 | Plan, schedule and execute work to ensure a supply of water for landscape purposes in adequate amounts and at adequate pressures for satisfactory irrigation of all plants. |
| 1.4 Handling and Storage | .1 | Store all grass seed and nurse crop seed, mulch, fertilizers and related materials, where required, in dry, weatherproof storage place and protected from damage by heat, moisture, rodents or other causes until time of seeding. Do not remove or deface labels or other identification. |
| 1.5 Drainage Control | .1 | Provide for proper water management and drainage of site during construction. Include silt traps, erosion control measures, temporary water collection ditches, as well as their adequate maintenance during construction period. |
| 1.6 Samples | .1 | Provide samples of all materials required, handle and ship in such a manner that they are representative of material or product sampled. |
| 1.7 Site Examination | .1 | Do not carry out landscaping work in areas or over surfaces that are not properly prepared. Examine site before starting work to verify all surfaces are properly prepared. |
| 1.8 Measurement and Payment | .1 | Refer to Section 02100, Measurement and Payment. |
| 1.9 Inspection and Testing | .1 | Refer to General Conditions, Clause 4.12, Inspections. |
| 2.0 PRODUCTS | | |
| 2.1 Grass Seed | .1 | Grass seed to meet requirements of Canada Seed Act for Canada No. 1 seed. Where specified, all nurse crop seed to meet requirements of Canada Seed Act for Canada No. 1 seed. |

- .2 Seed mixtures to be approved by Contract Administrator and to be suited to climate, terrain, establishment and maintenance conditions under which they are to be grown.
- .3 Seed to have minimum germination rate of 75% and minimum purity of 97%, except where otherwise required by professional selecting seed mixture.
- .4 Seed to be packed and delivered in original containers clearly showing:
 - .1 Name of Supplier
 - .2 Analysis of seed mixture.
 - .3 Percentage of pure seed.
 - .4 Year of production.
 - .5 Net weight (mass).
 - .6 Date and location of bagging.
- .5 Mixture to be mixed and supplied by recognized seed house

2.2 Water

- .1 Free of impurities that would inhibit germination and growth or may be harmful to environment.
- .2 Contractor to Supply

2.3 Fertilizer

- .1 Fertilizer to be in accordance with Section 02921 – Topsoil and Finish Grading – 2.9.

3.0 EXECUTION

3.1 Finish Grade Preparation

- .1 Do not perform work under adverse field conditions such as frozen soil, excessively wet or dry soil or soil covered with snow, ice or standing water.
- .2 Verify that grades are correct. If discrepancies occur, notify Contract Administrator and do not commence work until instructed by Contract Administrator.

- .3 Remove and dispose of weeds; debris; soil contaminated by oil, gasoline and other deleterious materials; to approved off-site disposal area.
- .4 Loosen surfaces of areas that are excessively compacted by means of thorough scarification, disking or harrowing, to minimum 150 mm depth.
- .5 Finish grade smooth to extent required for class of seeding to be carried out, firm against footprints, loose textured, and free of all stones, roots, branches, etc. larger than diameter required for removal for class of seeding to be carried out

3.2 Seeding – General

- .1 Scheduling: carry out seeding during periods that are most favourable for establishment of healthy stand of grass. Seed only during calm weather and on soil that is free of frost, snow and standing water, when seasonal conditions are likely to ensure successful germination and continued growth of all varieties of seed in grass mix.
- .2 Methods: apply seed by Method A- Mechanical Dry Seeding or Method B- Hydraulic Seeding unless otherwise specified. Ensure hydraulic seeding is in accordance with Section 02934 - Hydraulic Seeding. Hand seeding is not recommended. Hand seed only when site conditions preclude above two methods .
- .3 Rates of Application: rates of application of fertilizers, seed mixtures, mulch and other components to be based on analysis of season, climate, terrain, soil, and establishment and maintenance conditions affecting project.

**3.3 Application for
Mechanical
Dry Seeding**

- .1 Measure all grass seed, nurse crop seed, water, fertilizer, and mulch accurately before application .
- .2 Apply required fertilizer to and work well into topsoil by disking, raking, or harrowing at rate required.
- .3 Apply seed at rate required by means of approved mechanical dry seeder which accurately places seed at specified depth and rate and rolls in single operation .

- .4 Apply seed in two intersecting directions, except where conditions dictate seeding in one direction only.
- .5 Apply mulch with seed or immediately following seeding with approved mulcher. No area to be seeded in excess of that which can be mulched on same day.
- .6 Apply mulch to form even, uniform mat over entire area.
- .7 Use agricultural, water ballast type roller, not less than 500 mm diameter smooth steel drum, width not less than width of landscape seeder. Adjust ballast to suit site conditions.
- .8 Blend applications 150 mm into adjacent grass areas or previous applications to form uniform surfaces.

3.4 Application for Hand Seeding

- .1 Do not use hand seeding method unless approved by Contract Administrator.
- .2 Use all procedures specified in 3.3 of this Section, except as modified by specifications as follows:
 - .1 Use "Cyclone" type manually operated seeder. Adjust ballast to suit site conditions.
 - .2 Embed seed into soil to depth of 10 mm. Not less than 85% of seed to be placed at specified depth and covered by soil.
 - .3 Consolidate mechanically seeded areas by rolling area with manually operated, water ballast, landscaping type, smooth steel drum roller, immediately after seeding. Adjust ballast to suit site conditions.

3.5 Clean-up

- .1 Remove all materials and other debris resulting from seeding operations from job site.

3.6 Grass Maintenance

- .1 Begin maintenance for seeded areas immediately after seeding has been completed, and continue until issuance of Certificate of Total Performance.

- .2 Include all measures necessary to establish and maintain grass in a vigorous growing condition, including, but not limited to, following:
 - .1 Mow at regular intervals as required, to maintain grass at maximum height of 60 mm. Do not cut more than 1/3 of blade at any one mowing. Neatly trim edges of seeded areas. Remove heavy clippings immediately after mowing and trimming.
 - .2 Water when required and with sufficient quantities to prevent grass and underlying soil from drying out.
 - .3 Roll when required to remove any minor depressions or irregularities.
 - .4 Undertake weed control when density of weeds reaches 10 broadleaf weeds or 50 annual weeds or weedy grasses per 40 m² and reduce density of weeds to zero.
 - .5 Immediately repair seeded areas that show deterioration or bare spots. Top-dress all areas showing shrinkage due to lack of watering and seed with seed mix that matches original seed mix.
 - .6 Protect all seeded areas with warning signs, temporary wire or twine fences, or other necessary means.

3.7 Conditions for

Total Performance

- .1 Contract Administrator will issue Certificate of Total Performance only when following conditions exist:
 - .1 Growing medium quality, fertility levels, depths and surface conditions are as specified in Contract Documents.
 - .2 Grasses are required varieties, free of varieties other than those specified.
 - .3 Grass areas are relatively free of weeds, containing no more than two broadleaf weeds or ten annual weeds or weedy grasses per m²
 - .4 Grass is sufficiently established that its roots are growing into underlying growing medium.
 - .5 Seeded areas have been mown at least twice, to a height of 38 mm, last mowing being within 48 h of inspection for acceptance.
 - .6 Grasses established in sufficient density that no surface soil visible when mown to height of 38 mm.
 - .7 Specified maintenance procedures have been carried out.

**3.8 Guarantee /
Maintenance**

- .1 Customary one year guarantee period for construction industry will apply as standard for landscape work. Contractor to guarantee all materials and workmanship for a period of one full year from date of Total Performance, unless specified otherwise in Contract Documents.
- .2 Guarantee includes replacing all seeded areas determined by Contract Administrator to be dead or failing at end of guarantee period. Replacements to be made at next appropriate season, and conditions of guarantee will apply to all replacement seeding for one full growing season.
- .3 Guarantee will not apply to seeded areas damaged after date of Total Performance by causes beyond Contractor's control, such as vandalism, "acts of God", "excessive wear and tear", or abuse. Contractor is responsible for work until Total Performance. After Total Performance, Owner is responsible for work and proper maintenance.

1.0 GENERAL

- .1 Section 02934 refers to those portions of the work that are unique to the supply and application of grass seed by hydraulic methods. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 This section is based on the “British Columbia Landscape Standard” published by the B.C. Society of Landscape Architects and the B.C. Nursery Trades Association. This standard is intended to set a level of quality which is to be equalled or bettered in the construction documents for each project. Guidance of a registered British Columbia Landscape Architect is recommended.
- .3 This section is included for the work of reinstatement.

1.1 Related Work

- .1 Landscape Grading Section 02211
- .2 Topsoil and Finish Grading Section 02921
- .2 Seeding Section 02933
- .3 Hydraulic Seeding Section 02934
- .4 Sodding Section 02938
- .5 Planting of Trees, Shrubs, and Ground Covers Section 02950

1.2 References

- .1 British Columbia Landscape Standard.
- .2 Canadian System of Soil Classification.

1.3 Scheduling

- .1 Schedule all operations to ensure optimum environmental protection, grading, growing medium placement, planting, seeding or sodding operations as outlined in these Specifications. Organize scheduling to ensure a minimum duration of on-site storage of plant material, minimum movement and compaction of growing medium, and prompt mulching and watering operations. Coordinate work schedule with scheduling of other trades on-site.

- .2 Coordinate and schedule such that no damage occurs to materials before or after placement. In particular, meet requirements of living plant material.
- .3 Plan, schedule and execute work to ensure a supply of water for landscape purposes in adequate amounts and at adequate pressures for satisfactory irrigation of all plants.

1.4 Handling and Storage

- .1 Store all grass seed and nurse crop seed, hydraulic mulch, fertilizers and related materials, where required, in dry, weatherproof storage place and protect from damage by heat, moisture, rodents or other causes until time of seeding. Do not remove or deface labels or other identification.

1.5 Drainage Control

- .1 Provide proper water management and drainage of site during construction. Include silt traps, erosion control measures, temporary water collection ditches, as well as their adequate maintenance during construction period.

1.6 Samples

- .1 Provide samples of all materials required, handle and ship in such a manner that they are representative of material or product sampled.

1.7 Site Examination

- .1 Do not carry out landscaping work in areas or over surfaces that are not properly prepared. Examine site before starting work to verify all surfaces are properly prepared.

1.8 Measurement and Payment

- .1 Refer to Section 02100, Measurement and Payment.

1.9 Inspection and Testing

- .1 Refer to General Conditions Clause 4.12 – Inspections.

2.0 PRODUCTS

2.1 Grass Seed

- .1 Grass seed to meet requirements of Canada Seed Act for Canada No. 1 seed. Where specified, all nurse crop seed to meet requirements of Canada Seed Act for Canada No. 1 seed.

- .2 Seed mixtures to be approved by Contract Administrator and to be suited to climate, terrain, establishment and maintenance conditions under which they are to be grown.
- .3 Seed to have minimum germination rate of 75% and minimum purity of 97%, except where otherwise required by professional selecting seed mixture.
- .4 Seed to be packed and delivered in original containers clearly showing:
 - .1 Name of supplier.
 - .2 Analysis of seed mixture.
 - .3 Percentage of pure seed.
 - .4 Year of production.
 - .5 Net weight (mass).
 - .6 Date and location of bagging
- .5 Mixture to be mixed and supplied by recognized seed house.

2.2 Hydraulic Mulch

- .1 Hydraulic mulch to consist of fibre or other material designed for hydraulic seeding and dyed for ease of monitoring application.
- .2 Hydraulic mulch to be capable of dispersing rapidly in water to form homogeneous slurry and remaining in such state when agitated or mixed with other specified materials. When applied, hydraulic mulch to be capable of forming absorptive mat, which will allow moisture to percolate into underlying soil and to contain no growth or germination inhibiting factors. Mulch to be dry, free of weeds and all other foreign material, and to be supplied in packages bearing manufacturer's label clearly indicating weight and product name.
- .3 Mulch may contain a colloidal polythacuride (or equivalent) tackifier, which is to be adhered to mulch to prevent separation during shipment and to avoid chemical agglomeration during mixing in hydraulic mulching equipment.

2.3 Water

- .1 Free of impurities that would inhibit germination and growth or may be harmful to environment.
- .2 Contractor to supply.

2.4 Fertilizer

- .1 Refer to Section 02921 - Topsoil & Finish Grading – 2.9.

3.0 EXECUTION

3.1 Finish Grade Preparation

- .1 Do not perform work under adverse field conditions such as frozen soil, excessively wet or dry soil or soil covered with snow, ice or standing water or when wind exceeds 10 km/h.
- .2 Verify that grades are correct. If discrepancies occur, notify Contract Administrator and do not commence work until instructed by Contract Administrator.
- .3 Remove and dispose of weeds; debris; soil contaminated by oil, gasoline and other deleterious materials; to approved off-site disposal area.
- .4 Loosen surface areas that are excessively compacted by means of thorough scarification, discing or harrowing, to minimum 150 mm depth.
- .5 Finish grade smooth to extent required for class of seeding to be carried out, firm against footprints, loose textured, and free of all stones, roots, branches, etc. larger than diameter required for removal for class of seeding to be carried out.

3.2 Seeding - General

- .1 Scheduling: carry out seeding during periods that are most favourable for establishment of healthy stand of grass. Seed only during calm weather and on soil that is free of frost, snow and standing water, when seasonal conditions are likely to ensure successful germination and continued growth of all varieties of seed in grass mix.

- .2 Rates of Application: rates of application of fertilizers, seed mixtures, mulch and other components to be based on analysis of season, climate, terrain, soil, and establishment and maintenance conditions affecting project.

3.3 Equipment

- .1 All hydraulic seeding/mulching equipment to be calibrated and not to be removed or altered
- .2 Hydraulic seeder/mulcher to be capable of sufficient agitation to mix materials into homogeneous slurry and to maintain slurry in homogeneous state until application. Discharge pumps and gun nozzles to be capable of applying materials uniformly over designated areas.

3.4 Protection

- .1 Carry out hydraulic seeding with care to ensure fertilizer in solution does not come in contact with foliage of any trees, shrubs or other susceptible vegetation. Do not spray seed or mulch on objects not expected to grow grass.
- .2 Protect existing site equipment, roadways, landscaping, reference points, monuments, markers and structures from damage.
- .3 Promptly rectify any overspray or damage that occurs during hydraulic seeding.

3.5 Application for Hydraulic Seeding

- .1 When subgrade accepted by Contract Administrator commence placing growing medium.
- .2 Measure quantities of each material to be charged into hydraulic seeder/mulcher tank accurately either by mass or by commonly accepted system of mass-calibrated volume measurements. Add materials to tank while it is being filled with water and in following sequence: seed, fertilizer, and where applicable, mulch. Thoroughly mix materials into homogeneous water slurry and distribute uniformly over surface area with hydraulic seeder/mulcher .
- .3 Keep seeds for grass and legumes in separate containers prior to seeding .

- .4 If required, add legume seed to grass mixture at time of seeding. Inoculate legume seed with standard product humus culture before mixing with grass seed. Protect inoculated seed from exposure to sunlight for periods of over one-half hour. Use seed within eight hours from inoculation or to be re- inoculated .
- .5 After charging, do not add water or other material to mixture in hydraulic mulcher.
- .6 Do not leave seed, fertilizer, mulch and water slurry in tank for more than 4 h. Slurry left in tank over maximum time to not be used for seeding, dispose off- site.
- .7 If required, apply wild flower seed following grass hydroseeding.

**3.6 Erosion Control
Blanket**

- .1 Apply blanket over designated areas in accordance with manufacturer's instructions.
- .2 Anchor blanket in accordance with manufacturer's recommendations which are to be used as minimum standard and ensure that blanket is held down to maintain firm contact with soil.

3.7 Clean-up

- .1 Remove all materials and other debris resulting from seeding operations from job site.

3.8 Grass Maintenance

- .1 Begin maintenance for seeded areas immediately after seeding has been completed, and continue until issuance of Certificate of Total Performance.
- .2 Include all measures necessary to establish and maintain grass in a vigorous growing condition, including, but not limited to, following:
 - .1 Mow at regular intervals as required, to maintain grass at maximum height of 60 mm. Do not cut more than 1/3 of blade at any one mowing. Neatly trim edges of seeded areas. Remove heavy clippings immediately after mowing and trimming.
 - .2 Water when required & with sufficient quantity to prevent grass and underlying soil from drying out.

- .3 Roll when required to remove any minor depressions or irregularities.
- .4 Undertake weed control when density of weeds reaches 10 broadleaf weeds or 50 annual weeds or weedy grasses per 40 m² and reduce density of weeds to zero.
- .5 Immediately repair seeded areas that show deterioration or bare spots. Top-dress all areas showing shrinkage due to lack of watering and seed with seed mix that matches original seed mix.
- .6 Protect all seeded areas with warning signs, temporary wire or twine fences, or other necessary means.

3.9 Conditions for

Total Performance

- .1 Contract Administrator will issue Certificate of Total Performance only when following conditions exist:
 - .1 Growing medium quality, fertility levels, depths and surface conditions are as specified in Contract Documents
 - .2 Grasses are required varieties, free of varieties other than those specified
 - .3 Grass areas are relatively free of weeds, containing no more than two broadleaf weeds or ten annual weeds or weedy grasses per m²
 - .4 Grass is sufficiently established that its roots are growing into underlying growing medium.
 - .5 Seeded areas have been mown at least twice, to a height of 38 mm, last mowing being within 48 h of inspection for acceptance.
 - .6 Grasses established in sufficient density that no surface soil visible when mown to height of 38 mm.
 - .7 Specified maintenance procedures have been carried out.

3.10 Guarantee / Maintenance

- .1 Customary one year guarantee period for construction industry will apply as standard for landscape work. Contractor to guarantee all materials and workmanship for

a period of one full year from date of Total Performance, unless specified otherwise in Contract Documents.

- .2 Guarantee includes replacing all seeded areas determined by Contract Administrator to be dead or failing at end of guarantee period. Replacements to be made at next appropriate season, and conditions of guarantee will apply to all replacement seeding for one full growing season.
- .3 Guarantee will not apply to seeded areas damaged after date of Total Performance by causes beyond Contractor's control, such as vandalism, "acts of God", "excessive wear and tear", or abuse. Contractor is responsible for work until Total Performance. After Total Performance, Owner is responsible for work and proper maintenance.

1.0 GENERAL

- .1 Section 02938 refers to those portions of the work that are unique to the supply and application of grassed sod. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 This section is based on the “British Columbia Landscape Standard” published by the B.C. Society of Landscape Architects and the B.C. Nursery Trades Association. This standard is intended to set a level of quality which is to be equalled or bettered in the construction documents for each project. Guidance of a registered British Columbia Landscape Architect is recommended.
- .3 This section is included for reinstatement work.

1.1 Related Work

- | | |
|--|---------------|
| .1 Landscape Grading | Section 02211 |
| .2 Topsoil and Finish Grading | Section 02921 |
| .2 Seeding | Section 02933 |
| .3 Hydraulic Seeding | Section 02934 |
| .4 Sodding | Section 02938 |
| .5 Planting of Trees, Shrubs, and
Ground Covers | Section 02950 |

1.2 References

- .1 British Columbia Landscape Standard.
- .2 Canadian System of Soil Classification.

1.3 Scheduling

- .1 Schedule all operations to ensure optimum environmental protection, grading, growing medium placement, planting, seeding or sodding operations as outlined in these Specifications. Organize scheduling to ensure a minimum duration of on-site storage of plant material, minimum movement and compaction of growing medium, and prompt mulching and watering operations. Coordinate work schedule with scheduling of other trades on-site.

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- | | | |
|------------------------------------|----|---|
| | .2 | Coordinate and schedule such that no damage occurs to materials before or after placement. In particular, meet requirements of living plant material. |
| | .3 | Plan, schedule and execute work to ensure a supply of water for landscape purposes in adequate amounts and at adequate pressures for satisfactory irrigation of all plants. |
| 1.4 Handling and Storage | | |
| | .1 | Protect sod during transportation to prevent drying out. Sod to arrive at site in fresh and healthy condition. |
| | .2 | Install sod as soon as possible after delivery. If any delay in installation, keep sod moist and cool at all times until installation. |
| | .3 | During growing season, install sod within 24 h of delivery to site. |
| | .4 | Do not store sod on site more than 3 levels in height. |
| 1.5 Drainage Control | .1 | Provide for proper water management and drainage of site during construction. Include silt traps, erosion control measures, temporary water collection ditches, as well as their adequate maintenance during construction period. |
| 1.6 Samples | .1 | Provide samples of all materials required, handle and ship in such a manner that they are representative of material or product sampled. |
| 1.7 Site Examination | .1 | Do not carry out landscaping work in areas or over surfaces that are not properly prepared. Examine site before starting work to verify all surfaces are properly prepared. |
| 1.8 Measurement and Payment | .1 | Refer to Section 02100, Measurement and Payment. |
| 1.9 Inspection and Testing | .1 | Refer to General Conditions, Clause 4.12, Inspections. |
| 2.0 PRODUCTS | | |
| 2.1 Sod | .1 | Sod to be approved by Contract Administrator and to be nursery grown, true to type, conforming to standards of Nursery Sod Growers' Association and their Nursery Sod |

Specifications. Sod to be quality, cultured turf grass grown from seed approved by Canada Department of Agriculture, free of diseases, clovers, stones, pests and debris. Sod to be relatively free of weeds, containing no more than two broadleaf weeds or ten annual weeds or weedy grasses per 40 m².

- .2 Grass mixture in sod to be suited to locality, site conditions, and intended maintenance procedures for each project or area. Sod to be cut by machines designed for that purpose, and by accepted methods, and rolled for shipment. Strips to be 1 m² - 457 mm wide and 2.19 m long.
- .3 When lifted, height of grass in sod to be between 40 mm and 60 mm.
- .4 Sod to be lifted in such a manner as to prevent tearing or breaking:
 - .1 Name of Supplier
 - .2 Analysis of seed mixture.
 - .3 Percentage of pure seed.
 - .4 Year of production.
 - .5 Net weight (mass).
 - .6 Date and location of bagging.
- .5 Mowing height limit to be 38 mm to 64 mm and thickness of soil portion of sod to not exceed 25.4 mm or be less than 16 mm.
- .6 Grasses in sod to be of sufficient density that no surface soil to be visible when mowed to height of 38 mm.
- .7 Broken, dry, discoloured pieces will be rejected by Contract Administrator

2.2 Water

- .1 Free of impurities that would inhibit germination and growth or may be harmful to environment.
- .2 Contractor to Supply

2.3 Fertilizer

- .1 Fertilizer to be in accordance with Section 02921 – Topsoil and Finish Grading – 2.9.

3.0 EXECUTION

3.1 Finish Grade Preparation

- .1 Do not perform work under adverse field conditions such as frozen soil, excessively wet or dry soil or soil covered with snow, ice or standing water.
- .2 Verify that grades are correct. If discrepancies occur, notify Contract Administrator and do not commence work until instructed by Contract Administrator.
- .3 Remove and dispose of weeds; debris; soil contaminated by oil, gasoline and other deleterious materials; to approved off-site disposal area.
- .4 Loosen surfaces of areas that are excessively compacted by means of thorough scarification, discing or harrowing, to minimum 150 mm depth.
- .5 Finish grade smooth to extent required for class of seeding to be carried out, firm against footprints, loose textured, and free of all stones, roots, branches, etc. larger than diameter required for removal for class of seeding to be carried out

3.2 Sodding

- .1 Spread growing medium under all sodded areas evenly over approved subgrade to specified depth. See Section 02921 - Topsoil and Finish Grading.
- .2 Apply required fertilizer to and work well into growing medium by discing, raking or harrowing, at rates specified. Do within 48 h before laying sod.
- .3 Lay sod as soon as possible after delivery to prevent deterioration and lay within 24 h of delivery.
- .4 Lay sod staggered, closely knit together such that no open joints are visible, and no pieces overlap.

- .5 Lay sod smooth and flush with adjoining grass areas and paving and top surface of curbs unless shown otherwise on Contract Drawings.
- .6 On slopes of approximately 2:1 and steeper, lay sod lengthwise up slope, and peg every row with wooden pegs at intervals of not more than 0.5 metres. Drive pegs flush with sod.
- .7 Wooden pegs, for pegging sod on steep slopes, to be lath pegs. Pegs to be of sufficient length to ensure satisfactory anchorage of sod.
- .8 Where required, place erosion control mesh or netting and secure with stakes or staples sunk firmly into ground to minimum depth of 150 mm at maximum intervals of 4.5 m along pitch of slope. Place stakes or staples horizontally across slope at intervals equal to width of mesh or netting minus 150 mm and drive flush with top of sod.
- .9 Protect new sod from heavy foot traffic during laying. Place planks if necessary to prevent damage.
- .10 Cut sod where necessary only with sharp tools.
- .11 Roll, tamp, or plank sodded area providing sufficient pressure to ensure good bond between sod and growing medium
- .12 Water sod area immediately with sufficient amounts to saturate sod and upper 100 mm of growing medium

3.3 Clean-up

- .1 Remove all materials and other debris resulting from seeding operations from job site.

3.4 Grass Maintenance

- .1 Begin maintenance for sodded areas immediately after sod has been installed, and continue until issuance of Certificate of Total Performance.

- .2 Include all measures necessary to establish and maintain grass in a vigorous growing condition, including, but not limited to, the following:
 - .1 Mow at regular intervals as required, to maintain grass at maximum height of 60 mm. Do not cut more than 1/3 of blade at any one mowing. Neatly trim edges of seeded areas. Remove heavy clippings immediately after mowing and trimming.
 - .2 Water when required and in sufficient quantity to prevent grass and underlying soil from drying out.
 - .3 Roll when required to remove any minor depressions or irregularities.
 - .4 Undertake weed control when density of weeds reaches 10 broadleaf weeds or 50 annual weeds or weedy grasses per 40 m² and reduce density of weeds to zero.
 - .5 Immediately repair seeded areas that show deterioration or bare spots. Top-dress all areas showing shrinkage due to lack of watering and seed with seed mix that matches original seed mix.
 - .6 Protect all seeded areas with warning signs, temporary wire or twine fences, or other necessary means.

3.5 Conditions for

Total Performance

- .1 Contract Administrator will issue Certificate of Total Performance only when following conditions exist:
 - .1 Growing medium quality, fertility levels, depths and surface conditions are as specified in Contract Documents.
 - .2 Grasses are required varieties, free of varieties other than those specified.
 - .3 Grass areas are relatively free of weeds, containing no more than two broadleaf weeds or ten annual weeds or weedy grasses per m²
 - .4 Sod is sufficiently established that its roots are growing into underlying growing medium.
 - .5 Sodded areas have been mown at least twice, to a height of 38 mm, last mowing being within 48 h of inspection for acceptance.
 - .6 Grasses established in sufficient density that no surface soil visible when mown to height of 38 mm.

.7 Specified maintenance procedures have been carried out.

**3.6 Guarantee /
Maintenance**

.1 Customary one year guarantee period for construction industry will apply as standard for landscape work. Contractor to guarantee all materials and workmanship for a period of one full year from date of Total Performance, unless specified otherwise in Contract Documents.

.2 Guarantee includes replacing all sodded areas determined by Contract Administrator to be dead or failing at end of guarantee period. Replacements to be made at next appropriate season, and conditions of guarantee will apply to all replacement sodding for one full growing season.

.3 Guarantee will not apply to sodded areas damaged after date of Total Performance by causes beyond Contractor's control, such as vandalism, "acts of God", "excessive wear and tear", or abuse. Contractor is responsible for work until Total Performance. After Total Performance, Owner is responsible for work and proper maintenance.

1.0 GENERAL

- .1 Section 02950 refers to those portions of the work that are unique to the supply and planting of trees, shrubs and ground covers. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 This section is based on the “British Columbia Landscape Standard” published by the B.C. Society of Landscape Architects and the B.C. Nursery Trades Association. This standard is intended to set a level of quality which is to be equalled or bettered in the construction documents for each project. Guidance of a registered British Columbia Landscape Architect is recommended.
- .3 This section is included for reinstatement work.

1.1 Related Work

- | | |
|-------------------------------|---------------|
| .1 Landscape Grading | Section 02211 |
| .2 Topsoil and Finish Grading | Section 02921 |
| .2 Seeding | Section 02933 |
| .3 Hydraulic Seeding | Section 02934 |
| .4 Sodding | Section 02938 |

1.2 References

- .1 British Columbia Landscape Standard.
- .2 Landscape/Paysage Canada Guide Specification for Nursery Stock
- .3 Canadian System of Soil Classification.

1.3 Source Quality Control

- .1 Obtain approval from Contract Administrator of plant material at source prior to digging.
- .2 Imported plant material to be accompanied with the necessary permits and import licenses. Conform to federal and provincial regulations.

1.4 Scheduling

- .1 Schedule all operations to ensure optimum environmental protection, grading, growing medium placement, planting, seeding or sodding operations as outlined in these Specifications. Organize scheduling to ensure a

minimum duration of on-site storage of plant material, minimum movement and compaction of growing medium, and prompt mulching and watering operations. Coordinate work schedule with scheduling of other trades on-site.

- .2 Coordinate and schedule such that no damage occurs to materials before or after placement. In particular, meet requirements of living plant material.
- .3 Plan, schedule and execute work to ensure a supply of water for landscape purposes in adequate amounts and at adequate pressures for satisfactory irrigation of all plants.

1.5 Handling and Storage

- .1 Transport trees and plants to site in compliance with Section 8.1.2 of the British Columbia Landscape Standard to ensure proper protection.
- .2 Handle and store in compliance with Section 8.1.3 of the British Columbia Landscape Standard.
- .3 Take particular care to avoid damage and/or drying out until planting.
- .4 If damage occurs, take proper corrective measures to satisfaction of Contract Administrator or replace with new approved stock.

1.5 Drainage Control

- .1 Provide for proper water management and drainage of site during construction. Include silt traps, erosion control measures, temporary water collection ditches, as well as their adequate maintenance during construction period.

1.6 Samples

- .1 Provide samples of all materials required, handle and ship in such a manner that they are representative of material or product sampled.

1.7 Site Examination

- .1 Do not carry out landscaping work in areas or over surfaces that are not properly prepared. Examine site before starting work to verify all surfaces are properly prepared.

1.8 Measurement and Payment

- .1 Refer to Section 02100, Measurement and Payment.

**1.9 Inspection and
Testing**

- .1 Refer to General Conditions, Clause 4.12, Inspections.

2.0 PRODUCTS

2.1 Plant Material

- .1 Species: Selection of species to be as specified. Should specified species not be available, Contract Administrator to be notified so that an alternative choice can be made. Do not make substitutions without approval of Contract Administrator.
- .2 Origin:
 - .1 All plant material to be nursery grown stock or approved collected native plants unless specified otherwise
 - .2 All plant material to comply with British Columbia Landscape Standard for container grown plants and Landscape/Paysage Canada Guide Specification for Nursery Stock
 - .3 All nursery grown plants, as a minimum requirement, to comply with Landscape/Paysage Canada Guide Specification for Nursery Stock with respect to size, grade and quality.
 - .4 Collected native plants to be held and maintained in nursery until new root structures have adequately developed.
 - .5 Container plants to be grown for length of time necessary to achieve adequately developed root structure.
 - .6 Plants to be true to name, type and form, and representative of their species or variety.
 - .7 Plants to be compact and properly proportioned, not weak or thin, or injured by being planted too closely in nursery rows
 - .8 Plants to have normal, well-developed branches, vigorous fibrous root systems and to be healthy, vigorous plants free from defects, decay, disfiguring roots, sunscald injuries, abrasions of bark, plant diseases, insect pests' eggs, borers and all forms of infestation or objectionable disfigurements

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- .9 Trees to have straight stems (unless this is uncharacteristic) and to be well and characteristically branched for species or variety.
 - .10 Ground cover plants to have healthy tops to a size proportionate to above root requirements typical of species or variety .
 - .11 Rootballs and soil in containers to be free from pernicious perennial weeds .
 - .12 All trees and plants to be inspected by Contract Administrator upon delivery to site
- 2.2 Water**
- .1 Free of impurities that would inhibit germination and growth or may be harmful to environment.
 - .2 Contractor to Supply
- 2.3 Fertilizer**
- .1 Fertilizer to be in accordance with Section 02921 – Topsoil and Finish Grading – 2.9.
- 2.4 Mulch**
- .1 Bark mulch to be 25 mm minus Douglas Fir or Hemlock bark chips and fines, or combination of both, free of chunks and sticks, dark brown in colour, and free of all soil, stones, roots or other extraneous matter.
- 2.5 Stakes**
- .1 Pressure treated wood 50 to 70 mm diameter approximately 2 m long.
- 2.6 Guying Collar**
- .1 Tube: plastic, 13 mm diameter, nylon reinforced.
- 2.7 Wire Tightener**
- .1 Type 2: turnbuckle, galvanized steel.
- 2.8 Guying Wire**
- .1 Type 1: steel, 4 mm wire.
 - .2 Type 3: 3mm diameter multi-wire steel cable.
- 2.9 Clamps**
- .1 U-bolt: galvanized, 13 mm dia., c/w curved retaining bar and hexagonal nuts.
- 2.10 Anchors**
- .1 Wood: Type 1: 38 x 38 x 460 mm.
- 2.11 Anti-desiccant**
- .1 Wax-like emulsion.
- 2.12 Flagging Tape**
- .1 Fluorescent.

3.0 EXECUTION

3.1 Pre-planting Operations

- .1 Ensure plant material acceptable to Contract Administrator .
- .2 Remove damaged roots and branches from plant material.
- .3 Apply anti-desiccant to conifers and deciduous trees in leaf in accordance with manufacturer's instructions.

3.2 Subgrade Preparation

- .1 Establish subgrade for planting beds to Section 02211 - Landscape Grading.
- .2 Prepare planting beds to Section 02921- Topsoil and Finish Grading.
- .3 For individual planting holes:
 - .1 Stake out location and obtain approval from Contract Administrator prior to excavating.
 - .2 Excavate to depth and width as indicated.
 - .3 Remove subsoil, rocks, roots, debris and toxic material from excavated material that will be used as planting soil for trees and individual shrubs. Dispose of excess material.
 - .4 Scarify sides of planting hole.
 - .5 Remove water which enters excavations prior to planting. Notify Contract Administrator if water source is ground water.

3.3 Planting

- .1 Ensure all planting in general compliance with Section 8.3 of the British Columbia Landscape Standard.
- .2 Time of Planting:
 - .1 Complete planting work during normal planting seasons as dictated by prevailing weather conditions. Do not plant in frozen ground or with frozen rootballs, during extremely hot, dry weather, or during heavy rain.

- .2 Take all necessary precautions to protect plant material from prevailing weather conditions during transportation and planting.
- .3 Refer to Supplementary Specifications for any additional requirements that may apply to scheduling of planting.
- .3 Location of Planting: Plant trees as shown on Contract Drawings unless otherwise approved by Contract Administrator. Tree numbers, spacing and locations will vary according to site conditions and amenities. Stake locations as shown on Contract Drawings and verified on site with Contract Administrator prior to planting. If underground obstructions are uncovered report to Contract Administrator for resolution.
- .4 Planting Procedures - Trees and Shrubs:
 - .1 Plant all trees in holes large enough to accommodate entire rootball plus topsoil. Excavate holes diameter of rootball plus 600 mm. Backfill with topsoil to bring plant material to depth they were originally grown in nursery. Plant trees so that after settlement they will be at original growing medium depth.
 - .2 Fold back balled and burlapped stock top 1/3 of burlap without disturbing rootball. Remove container from grown stock before planting. Do not remove wire baskets.
 - .3 Backfill soil in 150 mm lifts. Tamp each lift to eliminate air pockets. When two-thirds of depth of planting pit has been backfilled, fill remaining space with water. After water has penetrated into soil, backfill to finish grade.
 - .4 Form watering saucer.
- .5 Bare Root Planting: while dormant only:
 - .1 Cut back damaged or broken roots to living parts remaining. Spread roots evenly in planting pit.
 - .2 Place growing medium around roots, gently shaking tree so all soil particles sift into root system to ensure close contact with all roots and to prevent air pockets. Avoid direct contact with roots of fertilizer (except slow release) and also of manure, if used.
- .6 Planting Procedures - Boulevard Plantings:

- .1 Deliver all plants for boulevard planting areas to site and protect from sun and drying winds. Keep plants that cannot be planted immediately on delivery well watered. Plant new plants within 3 days after delivery.
- .2 Plant plants so after settlement they will be at original growing medium depth. Allow for settling of growing medium after planting so that total depth of the rootball remains in topsoil.
- .3 Set plants plumb in planting beds or planting pits, except where plant's character requires variation from this.
- .4 Place growing medium in layers around roots or ball, preferably by hand. Carefully tamp each layer to avoid injuring roots or ball, or disturbing position of plant.
- .5 Upon completion of boulevard, rake planting soil to remove any debris brought to surface by planting operations. After raking mulch planting area with 75 mm of bark mulch placed in even layers over soil surface.
- .6 Once planting and mulching is complete, clean site of all excess soil, rock and debris.

3.4 Tree Support

- .1 Immediately following planting, install tree supports where required to brace trees in upright position to prevent excessive motion.
- .2 Install all stakes, clamps, anchors, collars, tighteners and guying wire such that no damage is done to tree.
- .3 Ensure all materials and procedures comply with accepted landscaping practices.
- .4 Repair all damage to satisfaction of Contract Administrator .
- .5 Owner will remove tree stakes when trees are stable .

3.5 Watering

- .1 Carry out watering as required and with sufficient quantities to prevent trees, plants and underlying growing medium from drying out.

3.6 Pruning

- .1 Limit pruning to minimum necessary to remove dead or injured branches and to compensate for loss of roots as a result of transplanting.
- .2 Prune in such a manner as to preserve natural character of plants.
- .3 Use only clean, sharp tools.
- .4 Clean and cut all cuts to branch collar leaving no stubs.
- .5 Trace cuts, bruises or scars on bark back to living tissue and remove.
- .6 Shape affected areas so as not to retain water, and paint all treated areas with a standard tree paint containing 1% naphthalene acetic acid.

3.7 Mulching

- .1 Immediately after all planting is complete and finish grading approved by Contract Administrator place bark mulch in even layers.
- .2 Ensure minimum depth of bark mulch 50 mm after settlement.

3.8 Clean-up

- .1 Remove all materials and other debris resulting from planting operations from site.

3.9 Maintenance

- .1 Perform following maintenance operations from time of planting to issuance of Certificate of Total Performance:
 - .1 Water to maintain soil moisture conditions for optimum establishment, growth and health of plant material without causing erosion.
 - .2 Remove weeds as required.
 - .3 Replace or respread damaged, missing or disturbed mulch.
 - .4 For non-mulched areas, cultivate as required to keep top layer of soil friable.
 - .5 Apply pesticides in accordance with Federal, Provincial and Municipal regulations as and when required to control insects, fungus and disease. Advise the Contract Administrator of products proposed for use prior to application.

- .6 Remove dead or broken branches from plant material.
- .7 Keep trunk protection and guy wires in proper repair and adjustment.
- .8 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.

3.10 Conditions for

Total Performance

- .1 Contract Administrator will issue Certificate of Total Performance only when following conditions exist:
 - .1 Growing medium quality, fertility levels, depths and surface conditions are as specified in Contract Documents.
 - .2 All plants are the specified species and varieties and planted in the locations shown on the drawings.
 - .3 All plants are healthy and turgid.
 - .4 Water content in growing medium is to satisfaction of Contract Administrator.
 - .5 All trees are staked as specified.
 - .6 All pruning is complete to satisfaction of Contract Administrator
 - .7 All planted areas are free of weeds
 - .8 Mulch is in place as required
 - .9 Unmulched areas are cultivated to leave a loose, friable, water- permeable surface

3.11 Guarantee /

Maintenance

- .1 Customary one year guarantee period for construction industry will apply as standard for landscape work. Contractor to guarantee all materials and workmanship for a period of one full year from date of Total Performance, unless specified otherwise in Contract Documents.
- .2 Guarantee includes replacing all plants determined by Contract Administrator to be dead or failing at end of guarantee period. Replacements to be made at next appropriate season, and conditions of guarantee will apply to all replacement plants for one full growing season.
- .3 Contract Administrator reserves the right to extend Contractor's guarantee responsibilities for an additional one year if, at end of initial guarantee period, leaf

development and growth is not sufficient to ensure future survival.

- .4 Guarantee will not apply to sodded areas damaged after date of Total Performance by causes beyond Contractor's control, such as vandalism, "acts of God", "excessive wear and tear", or abuse. Contractor is responsible for work until Total Performance. After Total Performance, Owner is responsible for work and proper maintenance.

1.0 GENERAL

- .1 Section 03200 refers to those portions of the work that that require nominal reinforcement such as cast-in-place manholes, small valve chambers and storm sewer end walls. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 This Specification is NOT to be used for any structural facilities such as buildings, bridges, retaining walls, or any similar structures requiring site specific structural engineering design.

1.1 Related Work

- .1 Excavating, Trenching and Backfill Section 02223
- .2 Waterworks Section 02666
- .3 Storm Sewers Section 02721
- .4 Pipe Culverts Section 02723
- .5 Manholes and Catchbasins Section 02725
- .6 Sanitary Sewer Section 02731
- .7 Sewage Force mains Section 02732
- .8 Cast-in-Place Concrete Section 03300

1.2 References

- .1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Section 02000 - Reference Specifications.

1.3 Certification

- .1 Inform Contract Administrator of proposed source of material to be supplied.
- .2 Provide certifications if required.

1.4 Shop Drawings

- .1 Refer to General Conditions, Clause 5, Shop Drawings.
- .2 Submit Shop drawings consisting of bar bending details, lists and placing drawings.

- .3 On placing drawings, indicate sizes, spacing, location and quantities of reinforcement and mechanical splices, with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacing and location of chairs, spacers and hangers. Drawings to be prepared in accordance with ACI 315R, Manual of Contract Administrating and Placing Drawings for Reinforced Concrete Structure.
- .4 Detail lap lengths and bar development lengths to CAN3-A23.3. Provide required tension lap splices.
- .5 Substitution of different size bars permitted only upon written approval of Contract Administrator.

1.5 Measurement and Payment

- .1 Refer to Section 02100, Measurement and Payment.

1.5 Inspection and Testing

- .1 Refer to General Conditions, Clause 4.12, Inspections.

2.0 PRODUCTS

2.1 Materials

- .1 Reinforcing steel: billet steel, grade as specified on Contract Drawings, deformed bars to CSA G30.12, unless indicated otherwise.
- .2 Reinforcing steel: weldable low alloy steel deformed bars to CSA G30.16.
- .3 Cold-drawn annealed steel wire ties: to CSA G30.3.
- .4 Deformed steel wire for concrete reinforcement: to CSA G30.14.
- .5 Welded steel wire fabric: to CSA G30.5
- .6 Welded deformed steel wire fabric: to CSA G30.15. Provide in flat sheets only.
- .7 Epoxy coating of non-prestressed reinforcement: to ASTM A775/A775M.
- .8 Galvanizing of non-prestressed reinforcement: to CSA G164, minimum zinc coating 610 g/m².
- .9 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1.

- .10 Mechanical splices: where specified or otherwise approved by Contract Administrator.
- 2.2 Fabrication**
 - .1 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
 - .2 Fabricate reinforcing in accordance with CAN/CSA-A23.1, ANSI/ACI 315, and ACI 315R, Manual of Contract Administration and Placing Drawings for Reinforced Concrete Structures.
 - .3 Obtain Contract Administrator's approval for locations of reinforcement splices other than shown on placing drawings.
 - .4 Upon approval of Contract Administrator, weld reinforcement in accordance with CSA W186.
- 3.0 EXECUTION**
 - 3.1 Field Bending**
 - .1 Do not field bend reinforcement except where specified or authorized by Contract Administrator.
 - .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
 - .3 Replace bars which develop cracks or splits.
 - 3.2 Placing Reinforcement**
 - .1 Place reinforcing steel as shown on reviewed placing drawings and in accordance with CAN/CSA-A23.1.
 - .2 Prior to placing concrete, obtain Contract Administrator's approval of reinforcing material and placement.
 - 3.3 Field Touch-up**
 - .1 Touch up damaged parts and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

1.0 GENERAL

- .1 Section 03300 refers to those portions of the cast-in-place work that are unique to the construction of pavements, sidewalks, curbs and gutters, manholes and catchbasins, concrete works associated with the installation of watermain and sewers, and similar works incidental to municipal services type construction. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 This Specification is NOT to be used for any structural facilities such as buildings, bridges, retaining walls, or any similar structure requiring site specific structural engineering design.
- .3 Except where specifically stated otherwise, all materials and methods in this Section to conform to requirements of the latest version of CAN/CSA – A23.1.

1.1 Related Work

- | | | |
|----|------------------------------------|---------------|
| .1 | Excavating, Trenching and Backfill | Section 02223 |
| .2 | Portland Cement Concrete Pavement | Section 02521 |
| .3 | Waterworks | Section 02666 |
| .4 | Storm Sewers | Section 02721 |
| .5 | Pipe Culverts | Section 02723 |
| .6 | Manholes and Catchbasins | Section 02725 |
| .7 | Sanitary Sewers | Section 02731 |
| .8 | Sewage Forcemains | Section 02732 |
| .9 | Concrete Reinforcement | Section 03200 |

1.2 References

- .1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Section 02000 - Reference Specifications- Site and Infrastructure.

1.3 Certification

- .1 Minimum 14 days prior to starting concrete work submit to Contract Administrator manufacturer's test data and certification by qualified independent inspection and testing

laboratory that following materials will meet specified requirements:

- .1 Portland Cement.
- .2 Blended Hydraulic Cement
- .3 Supplementary Cementing Materials.
- .4 Grout
- .5 Admixtures
- .6 Aggregates
- .7 Water
- .8 Waterstops
- .9 Waterstop joints
- .10 Joint filler

- .2 Provide certification acceptable to Contract Administrator that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1
- .3 Provide certification acceptable to Contract Administrator that mix proportions selected will produce concrete of specified quality, durability and yield and that strength will comply with CAN/CSA-A23.1

1.4 Construction Quality Control

- .1 Submit proposed quality control procedures for Contract Administrator's approval

1.5 Measurement and Payment

- .1 Refer to Section 02100, Measurement and Payment.

1.5 Inspection and Testing

- .1 Refer to General Conditions, Clause 4.12, Inspections.
- .2 Testing to conform to requirements of CAN/CSA – A23.1
- .3 Refer to CSA 283 Qualification Code for Concrete Testing laboratories.

2.0 PRODUCTS

2.1 Materials

- .1 Portland cement: to CAN/CSA – A5
- .2 Supplementary cementing materials: to CAN/CSA – A23.5
- .3 Water: to CAN/CSA – A23.1
- .4 Aggregates: to CAN/CSA – A23.1

- .5 Air entraining admixture: to CAN/CSA – A266.1
- .6 Chemical admixtures: to CAN/CSA – A266.2. Contract Administrator to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Grouts:
 - .1 Provide grout certification prior to use.
 - .2 To be as specified in Contract Documents. Alternatives to be approved by Contract Administrator prior to use.
 - .3 Use in accordance with manufacturer's recommendations
- .8 Curing Compound:
 - .1 To be spray applied, liquid type conforming to ASTM C309 containing a fugitive dye.
 - .2 To be applied in accordance with manufacturer's recommendations.
 - .3 Other curing methods such as sheet material and burlap mats, subject to Contract Administrator's approval
 - .9 Premoulded joint fillers: Bituminous impregnated fibre board: to ASTM D1751.

2.2 Concrete Mixes

- .1 Proportion concrete in accordance with CAN/CSA A23.1, Table 11, Alternative 1 and to specific design criteria specified on Contract Drawings.

2.3 Forms

- .1 Forms to: CAN/CSA – A23.1.11.
- .2 Free from surface defects for all concrete faces exposed to view.
- .3 Form ties to be metal and of type such that no metal left within 25 mm of concrete surface when forms removed.

2.4 Form Release Agent

- .1 Non-staining material type form release agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap

3.0 EXECUTION

3.1 General

- .1 Do cast-in-place concrete work, including surface tolerances, finishing and field quality control, in accordance with CAN/CSA – A23.1, except where specifically stated otherwise.

3.2 Formwork

- .1 Formwork to conform to shape, lines and dimensions shown on Contract Drawings.
- .2 Formwork to be substantial, sufficiently tight to prevent leakage of mortar and braced and tied to maintain position and shape.
- .3 Formwork to be unlined unless specified otherwise.

3.3 Workmanship

- .1 Obtain Contract Administrator's approval before placing concrete. Provide minimum 24 h notice prior to placing of concrete.
- .2 Pumping of concrete is permitted only after Contract Administrator's approval of equipment and mix..
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete obtain Contract Administrator's approval of proposed method for protection of concrete during placing and curing.
- .5 Ensure placement and compaction procedures to CAN/CSA – A23.1 and to approval of Contract Administrator.
- .6 Protect exposed surfaces from weather and vandalism during initial set period.
- .7 Strip forms ensuring no damage to concrete.
- .8 Ensure curing procedures consistent with weather and temperature conditions.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .10 Do not place load upon new concrete until authorized by Contract Administrator.

3.4 Joint Fillers

- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless authorized otherwise by Contract

Administrator. When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.

- .2 Locate and form all joints as shown on Contract Drawings or as otherwise required. Install joint filler where applicable.
- .3 Use 13 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to finished slab surface unless indicated at bottom.

END OF SECTION

1.0 GENERAL

- .1 Section 03400 refers to those portions of precast concrete work that are unique to the construction of pavements, sidewalks, curbs and gutters, manholes and catchbasins, chambers and similar works incidental to municipal infrastructure. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 This Specification is NOT to be used for any structural facilities such as buildings, bridges, retaining walls, or any similar structure requiring site specific structural engineering design.
- .3 Except where specifically stated otherwise, all materials and methods in this Section to conform to requirements of the latest version of CAN/CSA – A23.1.

1.1 Related Work

- .1 Excavating, Trenching and Backfill Section 02223
- .2 Concrete Reinforcement Section 03200

1.2 References

- .1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Section 02000 - Reference Specifications- Site and Infrastructure.

1.3 Construction Quality Control

- .1 Submit proposed quality control procedures for Contract Administrator's approval.

1.4 Measurement and Payment

- .1 Refer to Section 02100, Measurement and Payment.

1.5 Inspection and Testing

- .1 Refer to General Conditions, Clause 4.12, Inspections.

2.0 PRODUCTS

2.1 Materials

- .1 Precast concrete units to be constructed in accordance with CAN/CSA – A23.1 unless stated otherwise.

3.0 EXECUTION

3.1 General

- .1 Install precast concrete units, including surface tolerances, finishing and field quality control, in accordance with Contract Drawings.
- .2 Protection, storage and handling of precast concrete units to Manufacturer's recommendations.

END OF SECTION

1.0 GENERAL

- .1 Section 15000 addresses requirements for the supply and installation of Packaged Equipment. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 Mechanical equipment and piping materials supplied under this Contract shall be new and of current manufacture. Workmanship shall be of the highest quality; sub-standard work will be rejected.
- .3 The Contractor shall become familiar with all building plans including those of all sub-trades, and arrange equipment with due regard to all architectural, structural and electrical fixtures. The architectural, structural and electrical plans shall be consulted for final locations of walls, doors, equipment, etc.
- .4 Conflicts may be encountered. The Contractor shall confirm the nature of the work required prior to submitting a tender. No claim for additional work on the grounds that the Contractor did not anticipate actual requirements shall be considered.
- .5 The Contractor shall be responsible for providing complete and workable and functioning systems as outlined in the specifications and on drawings.
- .6 The Engineer will not recognize any sub-contractor as such, but will consider all persons engaged on the work to be under the control of the Contractor.
- .7 The Engineer will not enter into discussions concerning the responsibility of sub-contractor or apportionment of work. No claim based on the division of work between specification sections will be considered.
- .8 The Contractor shall be responsible for site safety.
- .9 All interruptions to existing services shall be at the convenience of the Community. Each interruption shall have prior approval. A minimum of one week's notice is required.

1.1 Potable Water Standard

- .1 Materials handling or conveying water shall be NSF-61 certified.

1.2 Substitutions

- .1 Supply approved equipment exactly as indicated by the drawings and specifications. Alternate materials may be substituted by the

Contractor only if such substitutions have been approved in writing by the Engineer.

**1.3 Site Storage/
Loading**

- .1 Co-ordinate delivery so that it is 'just in time' for field installation.
- .2 Confine work and operations of employees in accordance with Contract Documents. Do not encumber premises with products. Provide alternate access routes if necessary. The extensions of Cub Street and Cinnamon Street shall be available to the Contractor for construction staging, including materials lay-down, provided areas occupied by the Contractor for such use are reinstated as necessary.

**1.4 Handling and
Storage of
Equipment**

- .1 Equipment shall be adequately protected from damage during handling and from dust, dampness or any other injurious substance during delivery to the site, while at the site and after construction. Any damage which may occur during handling, shipping, or installation shall be made good by the Contractor at his expense. Equipment stored in unheated or open areas on the site shall be covered and provided with thermostatically controlled heaters of sufficient size to keep temperature of the equipment above the dew point.
- .2 Storage areas shall be made accessible to the Engineer at any time for the determination of the condition of storage.

1.5 Inspection

- .1 The Engineer reserves the right to inspect and test any material to be supplied under this specification at the manufacturer's plant or after arrival at the location specified for delivery. All materials, components, or parts which do not meet these specifications, the standards, or are defective, shall be replaced by the Contractor at his expense to the satisfaction of the Engineer.

1.6 Scheduled Outages

- .1 The Contractor shall co-ordinate with the District and the Engineer for any water system outages which might be required to install the works of this Contract e.g. Pressure Sustaining Station.
- .2 The Contractor shall schedule his work to minimize the time of the outage and shall work continuously on the work which necessitates the shut-down until the community water system is functioning normally again. If the work cannot be completed before the

Community reservoir water level falls into the emergency storage zone, then the Contractor shall make provision to haul potable water to the community reservoir at a sufficient rate to stay above the emergency storage level. The Community wells can be used for this purpose if required.

- .3 Meet the requirements of Item 1.7 'Scheduling of Work' in the Waterworks specification Section 02666

1.7 Measurement and Payment

- .1 Refer to Section 02100, Measurement and Payment.

2.0 SCOPE OF WORK

- .1 Supply, install and test equipment and piping necessary to complete the operating systems properly and fully, as specified herein and as shown on drawings, unless otherwise indicated. All materials, labour, tools and appliances necessary for this work shall be furnished by the Contractor.
- .2 The work of this Section shall include but not be limited to:
 - 1. Supply and installation of all necessary fittings, piping and appurtenances as detailed.
 - 2. Supply and installation of a packaged pre-fabricated pressure sustaining chamber.
 - 3. Supply and installation of a packaged pre-fabricated sodium hypochlorite metering/dosing system.
 - 4. Start up and commissioning.

2.1 Shop Drawings

- .1 As soon as possible after the award of the Contract, but not later than seven (7) days, the Contractor shall supply at least three (3) copies of drawings illustrating external dimensions and major structural details for the chamber, valves, fittings, piping, sodium hypochlorite metering/dosing system and all associated equipment to the Engineer for review.
- .2 In addition, at least three (3) copies of a bill of material listing the significant items of mechanical equipment proposed shall be provided. The materials used in the principal parts of the valves,

fittings, piping, and the materials specification to which these comply shall also be listed.

- .3 Wiring diagrams shall be supplied where applicable.
- .4 No more than four copies of drawings, schematics or bill of material will be reviewed by the Engineer. Maximum drawings size shall be 280 mm by 430 mm format.
- .5 When submitting the required drawings and bill of material, the Contractor shall advise the Engineer in writing of any changes or exceptions therein to the specification or related drawings. The Engineer will review these prints of the drawings or mark them with such corrections as are necessary and at least one (1) copy of the submitted drawings and bill of material will be returned to the Contractor stamped "reviewed" or as otherwise pertinent. Comments provided by the Engineer regarding the submittal shall be forwarded by the Contractor to the appropriate supplier.
- .6 The Contractor shall allow at least 1 week for the Engineer to review shop drawings. Any manufacturing done before approval of the drawings by the Engineer will be at the Contractor's risk.
- .7 The review of the Contractor drawings and bill of material shall be for determining the general conformance of the equipment with the design concept and shall not relieve the Contractor of any obligation under the Contract nor of his responsibility for any errors or omissions.

2.2 Record Drawings

- .1 The Contractor shall keep an accurate record of all field changes and modifications on a clean set of drawings as required, using accepted drafting techniques.
- .2 At the completion of the job, return these corrected drawings to the Engineer.

2.3 Operation and Maintenance Manuals

- .1 The Contractor shall furnish the Engineer with three (3) complete bound sets of typewritten or printed instructions, covering the proper method of operating and maintaining the equipment and systems included in this contract. It is also recommended that the Contractor retain a fourth copy of the manual for future reference.

- .2 Included within the manual shall be a spare parts list for each item. Also included within the manual shall be manufacturer's original printed operation and maintenance manuals covering specific items of equipment provided that may require field adjustment, programming or servicing, such as the pressure sustaining valves and the sodium hypochlorite metering/dosing system.
- .3 The manual shall also include all finalized shop drawings in 280 mm by 430 mm format. Binders shall be easily opened and reasonable space shall be available for the inclusion of design criteria and background information by the Engineer.
- .4 In addition, the contractor shall provide an electronic copy of the manual in portable document format (.pdf) on a CD-ROM (Compact Disc, read-only memory).
- .5 Copies of basic operation and maintenance manuals shall be made available by the Contractor at site during commissioning.

2.3 Start-up and Commissioning Service

- .1 Provide start-up and commissioning services for each packaged equipment provided.
- .2 Commissioning services may be either off-site certified testing, or on-site by the suppliers' field personnel.
- .3 Provide a minimum of 3 hours of on-site training to District personnel for each unit of packaged equipment by trained supplier personnel.

3.0 PRODUCTS

3.1 PRESSURE SUSTAINING STATION

.1 General

- .1 The pressure sustaining station shall be a pre-fabricated, packaged, pre-tested unit comprising a concrete chamber (upper section for access and lower section housing internals), installed pipe and valves (isolation and control), suitable for a buried installation. The station will be inserted into an existing water line on the south end of Cinnamon Street.
- .2 The station shall sustain the pressure on the well pump side of the station (lake side) so that it does not drop below 380 kPa (55psi gauge) and to open (remain open) if pressure on well side exceeds 450 kPa (65 psi gauge).

- .3 To maintain pressure requirements, the control valves shall include one lead and one lag automatic (hydraulic pilot controlled) pressure sustaining valves.
- .4 The pressure sustaining station shall be by Corix, or approved equal.

.2 Chamber

- .1 The precast concrete chamber shall be suitable for H-20 highway loading, and openings for access hatch, vents, drain and piping connections shall be as shown on the drawings. The chamber base section shall be supplied with a sump as detailed on the drawings. Exterior shall be black emulsion coated and interior white latex coated. Shall be Product Model 3152 (3.0 m x 1.5 m x 2.0 m inside height) as supplied by A.E. Concrete Precast Products Ltd..
- .2 Also provided shall be riser sections to provide a ceiling-to-access hatch height of approximately 1650 mm.
- .3 The top section of the chamber, and the riser sections, shall have 75mm of spray-on polyurethanes foam insulation, to R-21 rating and shall have a water-proof mixture in sealant.
- .4 Access ladder into the chamber shall be a corrosion resistant aluminum access ladder with box section rails, round non-slip rungs, 1A load rating and minimum 415 mm inside width, shall be provided. Featherlite 4240 (special base) approved. The ladder installation shall conform to current W.C.B. requirements.
- .5 Mounted to the upper end and behind the ladder shall be a spring balanced telescoping safety post with automatic lock. Complete assembly shall be of corrosion resistant construction. Bilco Ladderup Model LU-2 approved.
- .6 Access hatch assembly shall have a 900mm x 900mm door leaf of diamond pattern aluminum, rated for occasional traffic per CL625 ONT. Included shall be stainless steel continuous hinges, stainless steel spring assist, hold-open arm with release handle, flush lifting handle and recessed padlock hasp. All hardware shall be Type 316 and all fasteners shall be countersunk. On the inside of the access hatch/vault opening shall be fabricated stainless steel hangers such that a fabricated insulation panel (two 50mm layers of SM board, laminated on outside of both sides with 10mm thick pressure treated plywood and min. two aluminium handles) can easily be installed and removed from the existing ground surface. The

fabricated insulation panel shall be tight fit with no more than 5mm opening on any one side.

- .7 Provided shall be two 100 mm stainless steel vent pipes (refer to piping & fittings section for required specifications with the exception of using Sch 40 pipe), each with rodent screening and freeze protection damper (Valmatic Frostsaf approved).
- .8 Where piping passes through station walls, after insertion and final assembly of piping, the opening between the sleeve and the pipe itself shall be sealed by utilizing insertable elastomeric links, bolt compressed to expand. Links shall be of EPDM (ethylene propylene diene monomer) with composite plates and 316 stainless steel fasteners. Link assemblies shall be Link-Seal Model LS-300.

.3 Pressure Reducing/ Sustaining Valves

(Pilot Operated)

- .1 Provide pilot operated automatic pressure reducing/sustaining valves having an ASTM A536 cast ductile iron globe pattern body with ANSI class 150 flanged ends, ductile iron cover, fusion bonded epoxy coating conforming to AWWA C550/C116, 316 stainless steel stem, spring, seat & retainer, plus a full port seat nominally the same size as the valve end openings.
 - The lead valve shall be 50 mm with a 50 mm seat.
 - The lag valve shall be 100 mm with a 100 mm seat.
- .2 Valve piloting shall include lever operated isolating cocks at each body and cover tapping utilized, orifice type pilot restrictor, Y-type pilot supply strainer with fitted blow-off cock and hand tight brass hex plug, micrometer type opening speed control and position indicator with vent cock having 180° return tube. All pilots shall be of tin bronze (minimum 8% SN, 87% CU) or 316 stainless steel with seamless copper tube and flared brass fittings.
 - Lead valve: ClaVal 92-01 or Singer 106-PR-R approved
 - Lag valve: ClaVal 92-01 or Singer 106-PR-R approved

.4 Isolating Valves

- .1 Ball Valves (<50mm)
Shall be full-port ball type with Type 316 stainless steel body, floating ball, PTFE seats, stainless steel stem, quarter turn locking-lever handle and a minimum 6900 kPa (1000 psig) working pressure rating. MAS (M.A. Stewart) G2 approved.
- .2 Gate Valves (>75mm)

Shall be NRS (Non-Rising Stem) resilient wedge gate type, meeting the requirements of AWWA C-509 or C-515. Bodies shall be of ASTM A126 Class B cast iron having a fusion bonded epoxy coating, conforming to AWWA C550, with ANSI Class 150 flanged ends and a minimum 1725 kPa (250 psig) working pressure rating. The wedge gate shall be cast iron with full resilient encapsulation and acetal polymer guides. Screw shall be bronze and a stuffing box with dual o-rings shall be utilized. Handwheel shall be cast iron. Mueller A-2360-6, Clow F-6102, AVK 45/5X approved.

.5 Primary Strainers

- .1 Provided on each PRV inlet shall be an H-style strainer of ASTM A-536 ductile iron with AWWA C116/C550 fusion bonded epoxy coating, complete with 316 series standard 10 mesh stainless steel screen. Unit shall have a minimum 1725 kPa (250 psig) working pressure and suitable to the test pressure, and ANSI Class 150 flanged ends. Included shall be a 32mm blow-off ball valve. ClaVal X43H approved.

.6 Piping and Fittings

- .1 Threaded Steel Pipe
Threaded piping within the chamber, unless otherwise specified, shall be fabricated from ASTM A312 SMLS TP316 (316/316L) schedule 40 stainless steel pipe, pickled to NSF-61. Min. 100 mm long
- .2 Non-Threaded Steel Piping
All non-threaded piping within the pumping station shall be fabricated from schedule 40 ASTM A53, Grade B, SMLS, black carbon steel pipe with epoxy coating or schedule 10 ASTM A312, SMLS, TP316 (316/316L) stainless steel pipe pickled to NSF-61.
Branch outlets shall be fabricated utilizing Class 3000 FNPT Threadolet (Bonney Forge) connection fittings.
Grooved or roll groove ends shall be machine cut (Sch 40 pipe) or rolled (Sch 10 pipe) as per AWWA C-606 and coupling manufacturer specifications. Grooved couplings shall be rigid type, suitable for piping material and of epoxy coated ductile iron or 316 stainless steel with 316 stainless steel bolts and nuts. Galvanized products not acceptable. Victaulic Approved.
- .3 Grooved End Gaskets
Grooved end gaskets shall be Grade 'E' EPDM type. Victaulic Approved.
Grooved end gaskets shall be fully lubricated both inside and out with a manufacturer approved lubricant. Evidence of improper

lubrication at any connection shall be grounds for requiring all joints to be disassembled and re-lubricated.

The nuts of rigid type couplings shall be tightened to within manufacturer's specified torque range utilizing a torque wrench. Evidence of improper torque on any rigid coupling shall be grounds for requiring all rigid couplings to be disassembled and re-torqued.

.4 Welded Flanges

Welded flanges shall conform with ANSI B16.5 / AWWA C-207, ANSI Class 150, match pipe material (carbon steel or stainless steel) and pipe schedule to match pipe bore with either ASTM A105N, FFWN, epoxy coated or ASTM A182, FFWN, Grade F316 (316/316L).

.5 Fittings

Fittings shall match pipe material (carbon steel or stainless steel) and pipe schedule to match pipe bore with either ASTM A105N (15 – 37.5mm) / A420 (>50mm), epoxy coated or ASTM A182 (15mm-37.5mm) / A403 (>50mm), Grade S316 (316/316L).

.6 Bolting

Bolting shall be ASTM A193-B8M full thread stud bolts and ASTM A194-8M hex nuts, installed with anti-seize lubricant. Stud length shall be such that after the joints are made up the studs shall protrude at least two threads past the nut, but not more than 12 mm.

.7 Conventional Flange Gaskets

Garlock Multi-Swell 3760, Thickness 3.2mm (1/8"), Die Cut, aramid fibres in a nitrile elastomeric binder, continuous temperature rating 200 degrees Celsius.

**.7 Pipe / Valve Post
Floor Supports
(50 – 600mm)**

- .1 As appropriate, pipe and valves shall be supported by means of screw adjustable supports attached to the concrete floor utilizing Hilti stud type fasteners (stainless steel). These supports shall support the piping and shall be fabricated from 304/316 stainless steel, including the stand post.
- .2 These supports shall either be (1) attached to the lower portion of flanges by means of extra-length flange bolts (2) saddle support the underside of piping (3) full-circle saddle support the piping (4) cradle the underside of assembled flanges.
- .3 Height adjustment shall be accomplished by turning a single bolt, our coupling, at each support, and shall provide a minimum of

30mm adjustment both above and below the nominal height (total range 60mm minimum).

**.8 Inside Hose Bib
Assembly**

- .1 Provide a 20mm brass hose-bib complete with isolation ball valve.

**.9 Inlet / Outlet Combination
Auto Air Release Valve /
Pressure Gauge
Assembly**

- .1 Provided a combination automatic air release valve designed to relieve vacuum or air when line filling or draining, plus accumulated air when under pressure. Valve shall be suitable for potable water service and fitted with inlet isolating ball valve and outlet 180° return. Isolating valve and installation fittings shall be brass/bronze. Inlet shall be 25 mm NPT, body ASTM A536 ductile iron, minimum working pressure of 1035 kPa (150 psig) and suitable to test pressure. Apco 143C Approved.
- .2 Parallel to the combination automatic air release valve shall be an 8 mm lever operated isolating ball valve. Mounted atop this shall be a liquid-filled pressure gauge having a minimum 100mm dial, stainless steel case or brass and a dual scale reading 0-200 psi / 0-1400 kPa. Isolating valve and installation fittings shall be brass/bronze and hex nipples, not close type, shall be utilized.

.10 Coatings

- .1 Coatings shall be applied to all metal surfaces, with the exception of corrosion resistant materials, such as Stainless steel, copper or brass.
- .1 Water Immersed Applications
For inside of all piping, valves and fittings.
- .1 Coating system shall be suitable for raw water exposure in immersed environments at ambient temperatures, meet AWWA C-210, and NSF61. All surfaces should be assessed and treated in accordance with ISO 8504:1992. Oil or grease shall be removed per SSPC-SP-1 solvent cleaning.
- .2 Immersed surfaces shall be surface prepared to SSPC-SP-10 near white blast. If oxidation has occurred between blasting and application, the surface shall be reblasted to the specified visual standard. Surface defects revealed by the blast cleaning process, shall be ground, filled, or treated in the appropriate manner.

- .3 Immediately following surface preparation a prime coat of 2-component, tan or green coloured high build epoxy shall be applied by spray to a dry film thickness of 6.0 – 8.0 mils. International Interseal 670 HS coating material as available from CamCoat Industries approved.
- .4 This shall be followed by a final coat of 2-component, applied by spray to a dry film thickness of 6.0 - 8.0 mils. International Interseal 670 HS (EGA093) white coloured coating material as available from CamCoat Industries approved.
- .5 Grooved end piping and fittings shall be internally coated for immersed service, as well as on the outer gasket sealing band between each pipe groove and the end of the pipe or fitting.
- .6 Flexible rubber jacketed cables, liquid tight flexible conduit, nameplates, brass/copper, aluminium and stainless steel components and valve internals shall not be painted.

.2 Dry Exterior Applications

These shall include:

- Outside of all valve bodies
 - Outside of piping and fittings
- .1 Coating system shall be high durability (15+ year) rated and suitable for a classification C2 low corrosively environment per ISO Standard 12944. All surfaces should be assessed and treated in accordance with ISO 8504:1992. Oil or grease shall be removed per SSPC-SP-1 solvent cleaning.
 - .2 Surface prepare to SSPC-SP-6 commercial blast. If oxidation has occurred between blasting and application, the surface shall be reblasted to the specified visual standard. Surface defects revealed by the blast cleaning process, shall be ground, filled, or treated in the appropriate manner.
 - .3 Immediately following surface preparation a prime coat of 2-component, primer grey coloured epoxy anti-corrosive primer shall be applied by spray to a dry film thickness of 2.5 - 3.0 mils. International Intergard 251

coating material as available from CamCoat Industries, or ClovaPrime 21 as available from Cloverdale Paint approved.

- .4 This shall be followed by a final coat of 2-component, "Safety Blue" coloured epoxy applied by spray to a dry film thickness of 2.5 - 3.0 mils. International Intergard 740 coating material as available from CamCoat Industries, or ClovaCoat 833 Series available from Cloverdale Paint approved.

- .5 Flexible rubber jacketed cables, liquid tight flexible conduit, nameplates, brass/copper, aluminium and stainless steel components shall not be painted.

.3 Application Quality

- .1 The Supplier shall be responsible for self-inspection of the coating systems as outlined, but subject to independent inspection at all times.
- .2 The Supplier shall contract a NACE certified coating inspector, to inspect the work and provide written progress reports and digital photographs to the Engineer. Norske Corrosion and Inspection Services Approved.
- .3 Inspection shall be conducted immediately after surface preparation as well as each coating step.
- .4 The NACE certified coating inspector shall, provide the Engineer with a letter of verification upon completion of all required coating applications.

.4 Field Touch up Procedures

- .1 Damage to shop applied coatings occurring in storage, erection or installation shall be repaired to standards equal to the project specifications.
- .2 Immediately prior to repairing damaged or unpainted surfaces, and before the specified surface preparation is carried out, all grease, oil, dirt, and foreign matter shall be removed as per SSPC SP1.
- .3 Edges of sound remaining coating on the surface shall be feathered by sanding/grinding prior to painting.

- .4 Gloss paint surfaces shall be sanded or abraded to provide a bond for successive coats.
- .5 The minimum coating requirements for spot coating repairs shall be as follows:
 - No corrosion, primer exposed:
 - Apply one or more finish coats to restore specified film thickness.
 - No corrosion, primer damaged:
 - Clean area to substrate and reapply the specified system
 - Rusted areas:
 - After cleaning to the original standard of surface cleanliness,
 - Reapply specified system

.11 Testing

- .1 The supplier shall allow at least 2 weeks prior the contractor requesting to install the package for inspection and testing of the complete packaged station at the supplier's shop prior to shipping.
- .2 The required inspection and testing shall be:
 - 100% weld inspection
 - 100% assembly inspection
 - Water hydrostatic testing to 1,050 kPa (150 psig) with the following conditions:
 - Zero leakage: all connections, welds and suspect areas are dry
 - Pressure gauge remains at initial setting after 60 minutes
- .3 Supplier to re-perform test upon test failures, correct cause of failure, and re-test. All engineering time (at the engineer's hourly charge out rate) beyond one test shall be paid by the supplier.
- .4 The supplier is encouraged to test the package prior to arranging a witnessed test/inspection by the engineer. Any delay beyond one hour, the supplier shall pay the engineer's hourly charge out rate.

3.2 HYPO DISINFECTION SYSTEM

.1 General

- .1 Disinfection shall be by liquid 5% sodium hypochlorite but suitable for 12% solution if required.
- .2 The disinfection system shall be a pre-fabricated, packaged, pre-tested unit comprising a storage tank, a duplex metering/dosing

pump arrangement, installed pipe and valves, pressure gauge, pressure damping and relief arrangements, injection quill (isolation and control) and a calibration column. The duplex pumps and associated piping shall be mounted on a backboard suitable for a wall installation as shown on the drawings. The system will be installed into the Community's existing pump house comprising DN100 pipe.

- .3 Peak community water usage is 160 m³ per day. The pump house is serviced by two wells, each of which pumps at 11 L/s. Except on rare occasions, only 1 well pump operates at a time. The target dose level is 0.5mg/L.
- .4 Pump station static pressure is 260kPa (38psi) and dynamic pressure is 450kPa (65psi).
- .5 Each metering/dosing pump will be dedicated to one well pump. When the associated well pump is ON, the dosing pump will operate and vice versa. The ON/OFF signal will come from a PLC by others. Nevertheless, the dosing pumps shall be capable of switching to a signal paced system in the future should it be required, without physical dosing pump adaptations.
- .6 The disinfection system shall be by Prominent, or approved equal.

.2 Disinfection System

- .1 Shall be a Duplex Sodium Hypochlorite Metering / Dosing Pump System
- .2 Provide two (2) solenoid operated type sodium hypochlorite dosing pumps, each rated at 0.4L/h @ 6 bar.
- .3 Units shall operate from 120/60/1 electric receptacle
- .4 Pumping capacity/rate shall be by manual speed and stroke adjustment in the near term.
- .5 Pumps, valves, pipework and components shall be assembled and mounted on a backboard suitable for wall mounting.

.3 Backboard System Components

- .1 The disinfection package shall include the following assembled components:
 - 1 – Adjustable Pump Back Pressure Valve
 - 1 – Adjustable Pump Relief Pressure Valve

- 1 – Back/Relief Pressure setup gauge with isolation ball valve
 - 2 - Foot valves c/w 40 mesh strainers c/w single stage low level alarm float switch
 - Pulsation dampers as recommended by the supplier
 - Piping shall be of Sch. 80 PVDF material
 - Isolation ball valves provided as required
 - Pump and appurtenances shall be mounted on a PE or 316SS fabricated corrosion resistant backboard (or stand)
 - 1 – Air release valve, mounted above pipework, suitable for 5% - 12% Sodium Hypochlorite. Pipe the discharge from the valve back to the chemical storage tank.
 - Auto degassing valve and return line.
 - Front accessible user interface display/keypad
- .2 Do not use Teflon tape on threaded connections for sodium hypochlorite service.
- .3 The assembled package shall be pre-assembled, pre-piped, mounted and factory tested prior to shipment.

.4 Ancillary Components

- .1 The system shall include the following ancillary (“free issue”) components for inclusion in the works:
- 1 - PE sodium hypochlorite storage tank of 100L capacity on a 500mm high PE stand in a 750sq x 200mm high PE spill containment tray.
 - 1 - Hand held chemical transfer pump suitable for 5 - 12% sodium hypochlorite c/w with suitable length hose for chemical transfer.
 - 1 - Injector (quill) valve assembly c/w MNPT connection and isolation ball valve and banded ‘threadolet’ band tapped into existing pipe.

.5 Eyewash Station

Supply one pressurized portable eyewash station with the following requirements:

- .1 Piping and valves:
- 12.5mm BCP pipe
 - 12.5mm CP bronze stay-open ball valve with CP ball and SS valve stem
 - coiled hose and drench head
 - brass relief valve automatically opening at 800kPa
 - pressure gauge
 - SS push plate with actuation graphic

.2 Eyewash:

- ABC plastic heads and BCP Wye with SS bead chains securing covers
- self-adjusting to 1.5 Lpm

.3 Tank:

- 140L capacity
- 304SS ASME/CRN rated

.4 Manufacturer:

- similar to that manufactured by Encon

4.0 EXECUTION

- .1 Install packaged equipment generally as shown and noted on the drawings in accordance with the supplier's / manufacturer's recommendations.
- .2 Anchor as recommended by the manufacture
- .3 Flush and disinfect each entire package prior to installation or connection to existing pipe.
- .4 Isolate each package and perform field pressure testing after connections have been made to a pressure higher than ambient system pressure to demonstrate (and be witnessed) by the contract administrator that the system is free of leaks. As relevant, have tests witnessed prior to backfilling.
- .5 Agree and schedule with the engineer a time to have the field technician for each system to confirm calibrations, conduct on-site demonstration and field training after the system is in place and operable, but in the case of the disinfection system prior to exposure of the network to chlorine. Training shall be in the presence of the Community's operating personnel. Provide sheet for all training attendees sign-off, which shall also include a tick-box for topics covered, prior to field technician's departure.

1.0 GENERAL

- .1 All electrical equipment shall be furnished and installed on-site by an electrical contractor holding valid certification from the Electrical Safety Branch, Province of B.C. for the class of work required. The electrical contractor shall be exclusively responsible for the supply of such equipment. All electrical materials supplied under this Contract shall be new, of current manufacture, and shall bear the C.S.A. seal of approval, or other certification mark acceptable in the Province of British Columbia. Custom manufactured items shall be inspected and approved by a certification authority acceptable in the Province of British Columbia before being installed. The Contractor shall arrange and pay for such inspection and approval as necessary.
- .2 The electrical contractor shall provide a qualified industrial instrument technician with valid certification to ensure correct installation, configuration, calibration and operation of all process instrumentations.
- .3 Completed work shall be strictly in accordance with the current edition of the Canadian Electrical Code, including all amendments, and any local bylaws or rules regulating the installation of electrical equipment. All workmanship shall be of the highest quality and sub-standard work will be rejected.
- .4 The Contractor shall become familiar with the existing site, as well as all building plans including those of all sub-trades, and arrange equipment with due regard to all architectural, structural and mechanical fixtures. The architectural, structural and mechanical plans shall be consulted for final locations of walls, doors, equipment, etc.
- .5 The Contractor is warned that conflicts may be encountered and is advised to confirm the nature of the work required prior to submitting a tender. No claim for additional work on the grounds that the Contractor did not anticipate actual requirements will be considered.
- .6 The plans show approximate locations of equipment and apparatus but the right is reserved to make such changes in locations as may be necessary to meet the exigencies of construction in any way.

No claim will be allowed for such changes to any piece of electrical equipment or apparatus unless the distance moved exceeds 3 metres.

- .7 Allowance has been made in the design for the size and number of conductors which the Engineer considers adequate for serving the various items of equipment. These conductors and conduits are based on available data pertaining to a particular design of equipment. If the Contractor provides equipment which differs in connection requirements from the equipment shown, approval by the Engineer of the substitution shall not relieve the Contractor of his obligation to provide the necessary diagrams, services, materials and connections to the equipment as part of the work.
- .8 The Contractor shall be responsible for providing complete and workable systems as outlined in the specifications and on drawings. The Engineer will not recognize any sub-contractor as such, but will consider all persons engaged on the work to be under the control of the Contractor.
- .9 The Engineer will not, under any circumstances, enter into discussions concerning the responsibility of subtrades or the apportionment of work. No claim based on the division of work between specification sections will be considered.
- .10 The Contractor shall be responsible for site safety
- .11 All power interruptions to existing equipment shall be at the convenience of the District. Each interruption shall have prior approval.

2.0 SCOPE OF WORK

- .1 The Contractor shall supply, install and test all wiring and equipment necessary to properly and fully complete the operating systems as specified herein and as shown on drawings, unless otherwise indicated. All materials, labour, tools and appliances necessary for this work shall be furnished by the Contractor.
- .2 The Electrical work shall include, but not be limited to, the following:

Pump Station

1. Supply and installation of a new RTU control panel consisting of new ScadaPack RTU, Operator Interface, Alarm Dialer system and other control components.
2. Supply and installation of new power monitor in a new enclosure.
3. Modification of the existing pump starters and starter control panel as shown on drawings
4. Routing and connection of Flowmeter signal cable to new RTU control panel.
5. Supply and installation of a new wall thermostat.
6. Supply and installation of new UPS and UPS bypass switch.
7. Routing and connection of new Chlorine dosing pumps control cables to new RTU control panel.
8. Mark-up the assumed single line diagram to reflect the actual single line diagram, including equipment ratings if available.
9. Startup and commissioning.

Firehall

1. Disconnect call out function of reservoir level alarm so that alarm and acknowledge (alarm-silencer) is local at the firehall only. Reservoir level monitor to remain.

3.0 MEASUREMENT AND PAYMENT

1. Refer to Section 02100, Measurement and Payment.

4.0 SUBSTITUTIONS

.1 General

- .1 Tender shall be based upon utilizing an approved equipment manufacturer. Alternate equipment manufacturers will only be considered if offered as an option at time of tendering. Any reduction in cost shall be indicated at that time. The acceptance of

any such alternate manufacturer shall be at the option of the City. The acceptance of any such alternate manufacturer shall be at the option of the District.

**5.0 PERMITS AND
INSPECTION**

- .1 The Contractor shall make himself fully acquainted with all codes and bylaws relating to the installation of equipment. He shall obtain and pay for all permits required for the execution and inspection of his work and pay all charges relating to such permits.

**6.0 SHOP DRAWINGS
AND TESTS**

- .1 Prior to commencing manufacture of the RTU control , the Contractor shall provide at least three copies of drawings illustrating external dimensions and major structural details to the Engineer for review. These drawings shall also show the proposed general layout of equipment within the RTU control panel, and shall include the ratings of all electrical devices where applicable.
- .2 At least three copies of single line distribution and control wiring schematics shall also be furnished.
- .3 In addition, at least three copies of a bill of material listing the significant items of electric equipment proposed shall be provided. Additional information shall be provided for major items of electrical equipment as necessary to illustrate the functions provided. When submitting manufacturer's data sheets, the selected components shall be highlighted.
- .4 No more than eight copies of drawings, schematics or bill of material will be reviewed by the Engineer. Maximum drawings size shall be 280 mm by 430 mm format.
- .5 When submitting the required drawings and bill of material, the Contractor shall advise the Engineer in writing of any changes or exceptions therein to the specification or related drawings. Subsequent to review, at least one copy of the submitted drawings and bill of material will be returned to the Contractor stamped "reviewed" or as otherwise pertinent. Any attached comments provided by the Engineer regarding the submittal shall be forwarded by the Contractor to the appropriate supplier.

- .6 The Contractor shall allow at least one week for the Engineer to review shop drawings. Any manufacturing done before review of the drawings by the Engineer will be at the Contractor's risk.
- .7 The review of the Contractor drawings and bill of material shall be for determining the general conformance of the equipment with the design concept and shall not relieve the Contractor of any obligation in the Contract nor of his responsibility for any errors or omissions.
- .8 Before the RTU control panel is shipped to the job site, the Engineer shall be given five working days notice of a time that the assembly may be inspected at the point of manufacture. At that time, the Contractor shall demonstrate to the Engineer the correct functioning of control inputs and outputs, plus any other devices that can reasonably be tested.
- .9 The manufacturer shall be capable of energizing the completed assembly at design line voltage, without any secondary loads, such that motor control equipment can be tested and pre-configured.

7.0 RECORD DRAWINGS

- .1 The Contractor shall keep an accurate record of all field changes and modifications on a clean set of drawings as required, using accepted drafting techniques.
- .2 At the completion of the job, return these corrected drawings to the Engineer.

8.0 OPERATION AND MAINTENANCE MANUALS

- .1 The Contractor shall furnish the Engineer with three (3) complete bound sets of typewritten or printed instructions, covering the proper method of operating and maintaining the equipment and systems included in this contract. It is recommended that the Contractor retain a fourth copy of the manual for future reference.
- .2 Included within the manual shall be manufacturer's original printed operation and maintenance manuals covering specific items of equipment provided that may require field adjustment, programming or servicing, such as the power monitor relay, Remote Terminal Unit, operator interface, uninterruptible power supply or autodialer.

- .3 The manual shall include, if available, at a minimum:
 - Full User Manual
 - Installation Instructions
 - Full list of Parameters/ Programming Manual
 - Troubleshooting/ Maintenance Manual
- .4 The manual shall also include all finalized shop drawings in 280 mm by 430 mm format, the catalogue numbers of all the electrical equipment installed and the manufacturer's parts lists. Binders shall be easily opened and reasonable space shall be available for the inclusion of design criteria and background information by the Engineer. Binders shall be large heavy duty expanding 3-post binders. Binder identification shall include project name & number, contractor's name, consultant's name and binder volume number.
- .5 In addition, the contractor shall provide an electronic copy of the manual in portable document format (.pdf) on a CD-ROM (Compact Disc, read-only memory).
- .6 Copies of basic operation and maintenance manuals shall be made available by the Contractor at site during commissioning.

9.0 HANDLING AND STORAGE OF NEW EQUIPMENT

- .1 All electrical equipment shall be adequately protected from damage during handling and from dust, dampness or any other injurious substance during delivery to the site, while at the site and after construction. Any damage which may occur during handling, shipping, or installation shall be made good by the Contractor at his expense. Equipment stored in unheated or open areas on the site shall be covered and provided with thermostatically controlled heaters of sufficient size to keep temperature of the equipment above the dew point.
- .2 Storage areas shall be made accessible to the Engineer at any time for the determination of the condition of storage.

10.0 INTERFERENCE WITH STATION OPERATION

- .1 As each station is an integral part of the District water distribution system:
 1. The Contractor shall provide with tender a brief

methodology of how the completion of work is proposed, to assure minimum interruption of operation at each station site. Any work done before the review and approval of proposed methodology will be at the Contractor's risk.

2. All power interruptions to existing equipment shall be at the convenience of the District. Each interruption shall have prior approval.
3. The Contractor shall fully collaborate with operations staff and observe required protocols before commencing construction. Lockout procedures shall be established and employed. Contractor shall provide an emergency response plan, and a 24 hour contact in case of emergency.

11.0 REMOVAL

OF EQUIPMENT

- .1 All equipment removed from site shall, at the discretion of the District, either be delivered and offloaded at the Works Yard, or disposed of in a legal manner. Necessary transportation and approvals shall be the responsibility of the Contractor. Equipment shall not be removed until it is no longer required to maintain station operation.

12.0 FIELD PRACTICES

12.1 Conduit, Ducting, and Fittings

- .1 All exposed conduit shall be of rigid PVC, aluminum or approved galvanized rigid steel with PVC jacket, Wavell/Robroy approved.
- .2 Rigid PVC conduit and fittings shall be Sch.40 and meet CSA C22.2 No.211.2 and FT4 standards. Royal Pipe Systems (1-800-663-0696), IPEX Scepter (604-534-8631) approved.
- .3 All exposed conduit shall be installed parallel to building lines in a neat and workmanlike manner.
- .4 Conduit runs to equipment shall be either run through concrete where indicated, or run near floor level and adjacent to piping in order to minimize tripping hazard. Drop runs to equipment from the ceiling are not permissible, unless special authorization has been received from the Engineer.

- .5 A 500 mm minimum length of liquid tight flexible conduit shall be installed at all motor and instrumentation connections. In potentially corrosive environments, liquid tight flexible conduit and fittings shall be non-metallic, Hubbell Polytuff Grey, T&B Liqueatite LNMP Grey or approved equal. Non-liquid tight flexible metal conduit will be permitted for suspended luminaries.
- .6 Approved extension fittings shall be used whenever conduit crosses building expansion joints.
- .7 Where a conduit leaves a warm room and enters a cooler atmosphere it shall be sealed so as to prevent breathing and subsequent condensation. This shall be done in such a manner that condensate will not be trapped at the seal.
- .8 Unused conduits shall be sealed at each end using threaded metal electrical conduit caps.

12.2 Hangers and Fastenings

- .1 Use metal inserts, hangers and fastenings for the support of electrical equipment and conduit. Non-metallic fastenings and supports will not be accepted.
- .2 In potentially corrosive environments all support channels and fittings shall be of 300 series stainless steel, 6063-T6 aluminum or FRP with ends re-sealed.
- .3 The ends of metal support channels shall be capped with metal end caps from the same manufacturer.

12.3 Seismic Restraint

- .1 Electrical equipment shall be seismically restrained by the Contractor.

12.3 Equipment Finish

- .1 Sheet metal boxes, cabinets and enclosures are to be free of rough edges and sharp corners. All visible enclosure cutouts shall be neat, filed smooth and touch-up paint applied to exposed metal. All equipment shall be left in as new condition. The Contractor shall repair, clean, refinish or replace any damaged surface.

- .2 All shipping labels, markings, tags and tape shall be removed, along with any remaining residue.

12.4 Wire and Cables

- .1 Unless otherwise specified or shown on the drawings, all wires shall be RW90, XLPE insulated, minimum #12 AWG stranded copper.
- .2 Wire smaller than #12 AWG shall not be used for branch circuit work. For control circuits, #14 stranded copper wire may be utilized.
- .3 Raceway or enclosure instrumentation cable shall have #18 stranded conductors, individually twisted pair shielded with shields grounded at one end only (opposite instrument) in accordance with good installation practices to minimize noise interference. Belden #8760 (2-wire), #8770 (3-wire) approved.
- .4 Ethernet communication shall be over four pair #24 solid conductor cable without shield and flame resistant blue jacket rated for plenum installation. Cable shall be ANSI/ETA/TIA 568-B.2, Category 5E third party verified. Belden #1585A approved.
- .5 At all locations discrete, analog, intrinsically safe and power wiring shall be physically separated to the maximum extent possible. In no case shall wire bundles contain mixed signal types.
- .6 In potentially corrosive environments, all connections shall be treated with an anti-seizing oxide inhibiting compound. Burndy Penetrox A-13 or Blackburn Contax CT approved.

12.5 Grounding and Bonding

- .1 A bonding conductor shall be installed along with power conductors in all conduit runs, regardless of the type of conduit being used.
- .2 Electronic equipment grounds shall be connected by parallel conductors to a common point, which in turn is connected by #4 insulated ground wire, or larger conductor, directly to the main site ground.

12.6 Nameplates

- .1 Supply and install engraved lamicoïd nameplates having black letters on white background to identify all field mounted enclosures, including disconnect switches, transformers, meters,

operator devices and indicating lights. Alternatively, factory legend plates or engraved device operators can be used to identify HAND-OFF-AUTO selector switches and mechanical overload RESET buttons. Lighting switches shall also be identified whenever more than one lighting system is involved. Each nameplate shall indicate the function of the equipment within and, where applicable, shall include the appropriate equipment number.

- .2 Nameplates shall be sized appropriately to the equipment on which the plates are mounted.
- .3 Suitable warning lamicoids, having white letters on red background, shall be applied to enclosures as applicable:

WARNING - ENCLOSURE IS FED BY MORE THAN ONE SOURCE OF ENERGY

12.7 Testing

- .1 On completion of the work, and after complete testing by the Contractor, the equipment shall again be tested, and operation demonstrated, as directed by the Engineer. The Contractor shall furnish equipment and trained personnel to assist in this testing. The Contractor shall also provide as required the services of factory representatives for startup of specialized equipment. Any deficiencies or unsatisfactory work shall be promptly remedied by the Contractor to the satisfaction of the Engineer.
- .2 All equipment shall be installed, wired, calibrated, configured and tested in strict accordance with the manufacturer's instructions and good instrumentation practice. **Where the installation of field instrumentation is required, the Contractor shall have available an analog loop calibrator capable of simulating and measuring 4-20 mA current signals.**
- .3 Where Opus DaytonKnight is providing the programming for a PLC or RTU, the Contractor shall provide a small table and chair and, if outdoors, suitable weather protection canopy for the programmer during commissioning.
- .4 A 1000 volt Megger shall be available during testing and shall be sized sufficiently large to thoroughly saturate the circuit under test. Any ground, short circuit or work which, in the opinion of the Engineer, does not have a high enough Megger reading shall be immediately repaired. Any conductor to ground reading below 2 megohms will not be acceptable.

- .5 In the event that the work, in the opinion of the Engineer, is found not to be substantially ready for testing then a subsequent testing session shall be scheduled by the Contractor without additional cost. In such an event, the Contractor may be deemed liable for expenses incurred by the Engineer.

13.0 CONTROL PANEL

ASSEMBLY

- .1 Prior to commencing manufacture of the RTU control panel, the arrangement of door and interior components shall first be shop reviewed and approved by the Engineer.
- .2 A sheet metal cover, painted to match the rest of the door, shall be provided over existing unused enclosure door cut-outs.
- .3 Control panel enclosure shall be single door type, fabricated to EEMAC 12 standards. A removable inner mounting panel shall also be provided for equipment mounting, and shall be primed and finished in white enamel. Enclosure shall be by Hoffman, Hammond, Rittal, Eurobex, Ralston.
- .4 All components shall be mounted to the inner mounting panel with Robertson head (square socket) machine screws in tapped holes.
- .5 Relay sockets shall be mounted on a common track with spare length for at least two additional relay sockets. Terminals shall also be track mounted and a minimum 15% shall be unused spares.
- .6 Control wiring shall be #16 Type TEW, identified and colour coded as follows:
- | | | |
|---------------------------|---|--------|
| Hot AC | : | Black |
| Neutral AC | : | White |
| Control (switched) AC | : | Red |
| Positive & Control DC | : | Blue |
| Negative DC | : | Yellow |
| Instrumentation (sensors) | : | Orange |
- .7 All wires shall terminate with crimp-on type ends.
- .8 Analog signal cabling shall be Belden #8760, 2 wire shielded.
- .9 Control wires shall be identified at each end with markers and identification numbers shall match terminal numbers. Provide "Tyrap" wireways, secured to rear mounting panel, or "Panduit"

type wiring trough. Door bundles shall be "Spiralflex" enclosed and mechanically secured at each end. Adhesive pads will not be acceptable.

- .10 A minimum of six spare wires shall be brought through the door bundle, terminating unconnected at the end of the door component wiring.
- .11 The control panel shall bear the C.S.A. seal of approval, or other certification mark acceptable in the Province of British Columbia, and be manufactured by an electrical control panel manufacturer regularly engaged in this type of work. Manufacturer shall be:
 - Allied Controls Ltd. (604-420-1630)
 - Celco Control Ltd. (604-461-4547)
 - Softac Systems (604-888-9507)
 - PLC Technical Services (604-209-9607)
 - Western Integrated Systems (604-430-1202)
 - Arrow Speed (604-321-4033)
 - Turn-Key Controls (604-539-1201)
 - Harbourview Electric (604-430-4777)
 - Interior Instrument Tech Services Ltd. (250-717-8813)
 - GLC Controls Inc. (1-877-903-4343)
- .12 Tender shall be based upon utilizing an approved control section manufacturer. Alternate control section manufacturers will only be considered if offered as an option at time of tendering. Any reduction in cost shall be indicated at that time. The acceptance of any such alternate manufacturer shall be at the option of the District.
- .13 The manufacturer shall be capable of energizing the completed assembly at design line voltage, without any secondary loads, such that motor control equipment can be tested and pre-configured.

14.0 CONTROL PANEL

- APPURTENANCES**
- .1 Secondary circuit breakers shall be 35mm DIN rail mounted, have a trip indicator and either a "push-to-trip" button or O/I toggle. Circuit breakers shall be Allen-Bradley 1492-GH, Weidmuller type CB4200, Cutler-Hammer WMS1C, IDEC NRC110L-AA, ABB S200-C, or Phoenix UT 6-TMC M 16A.
 - .2 Control terminals for discrete I/O shall be of the tubular screw with pressure plate type and suitable for two #14 wires per terminal, or front-entry cage clamp type with jumpers and suitable

for one #14 wire per terminal. Terminals shall be track mounted on 35mm DIN rail. Discrete control terminals shall be Entrelec 115116.07, Phoenix UK6N, Wieland WK6/U, Weidmuller WDU6, Wago 282, or Cutler-Hammer XBU.

- .3 Control terminals for analog input signals shall provide three connections per side, each suitable for #22-12 wire. Terminals shall be track mounted on 35 mm DIN rail. Analog control terminals shall be Weidmuller MC6-INS/991784-1000, complete with a single DLS-MC6-INS/991785-1000 test lead.
- .4 Selector switches, indicator lights and pushbuttons shall be industrial 30 mm oil tight type and of the same manufacturer throughout.
- .5 Control relays shall be 4-pole double-throw plug-in type, rated minimum 6A and with test operator and track mounted sockets. Control relays shall be OMRON LY4I4, or IDEC RU4S.
- .6 Timing relays shall be 2-pole double-throw plug-in type with track mounted 8-pin sockets. Timing relays shall be OMRON H3CR-A8-AC100-240 (TDE Type) / H3CR-H8L (TDDE Type), or IDEC GE1A-C10HA110 (TDE Type) / GT3F-2EAF20 (TDDE Type).
- .7 Analog signal isolators shall be 4-wire main powered with a 25 ohm unit impedance and capable of driving into a 600 ohm output impedance. Unit shall have an acceptable voltage of 120 VAC. Shall be Moore ECT/4-20MA/4-20MA as available from C.B. Engineering (604-739-6125).
- .8 Analog signal isolators shall be 4-wire main powered with 2-wire transmitter excitation, with a 25 ohm unit impedance and capable of driving into a 600 ohm output impedance. Unit shall have an acceptable voltage of 120 VAC. Shall be Moore ECT/4-20MA/4-20MA/-TX as available from C.B. Engineering (604-739-6125).

15.0 PROGRAMMABLE LOGIC CONTROLLER

15.1 Remote Telemetry

Unit (RTU)

- .1 Control logic shall be provided by Control Microsystems SCADAPack-334 system consisting of:

P334-1-A20AD10
5403-120

Processor with 5607 I/O board
Discrete input module (8 pt)

- .2 As far as practical, input conductors shall be separated from power and output conductors. Assembly shall be mounted on horizontal rail.
- .3 RTU programming will be provided by Opus DaytonKnight Ltd. The Contractor shall furnish a copy of Control Microsystems Telepace Studio system programming software, registered to the District, when shop drawings are submitted.
- .4 After inspection of the RTU control panel by engineer, the RTU and the operator interface shall be removed and sent to Opus DaytonKnight Ltd. for programming.
- .5 The completed program will be loaded into the RTU processor just prior to startup and testing of control and starter functioning.

16.0 OPERATOR

INTERFACE PANEL

- .1 Provide an operator interface panel with a 4-color foil print, 800 x 600 pixel, high-resolution 265 mm (10.4") TFT-display. Unit shall be rated to IEC IP66, and shall be centred 1500 mm above service floor level.
- .2 A slot installed 128 MB compact flash (CF) memory card shall be included.
- .3 Shall be Beijer Exter T-100 Operator Interface Panel, plus Information Designer and programming software, as available from Mica Controls (403-450-7517).
- .4 Operator interface panel programming will be provided by Opus DaytonKnight.

17.0 REMOTE ACCESS

ETHERNET SWITCHED

MODEM

- .1 Remote access dial-in switched modem shall have four (4) port 10/100 BaseTX RJ-45 auto sensing communication ports with LED indication of power application and individual link/activity status. Shall be Allen-Bradley 9300 RADES. Wiring to Telus Communications demarcation block shall be provided.

18.0 INSTRUMENTATION .1 Power Supply (24 VDC)

24 VDC supply power shall be provided by a switching power supply with single output terminal, Class 2, capable of handling up to a 2.5A load. Unit shall be enclosed, 35 mm DIN rail mounted and shall be IDEC PS5R-SD24 or OMRON, Phoenix, Weidmuller or Sola equivalent.

.2 Surge Protection

External telephone lines shall be protected from cable surges by coordinated multistage line protectors, applied as follows:

2-wire telephone Emerson EDCO FAS-TEL-200

**19.0 TELEPHONE
AUTODIALER**

- .1 The telephone autodialer shall be main module, communication module capable of communicating with Modbus TCP and T1 module capable of accepting up to 8 either N.O. or N.C. alarm inputs and, after an adjustable 0-20s time delay, subsequently dialing up to 16 telephone numbers from each of four available directories. Site and alarm shall be identified by a digital toll quality voice. Unit shall also provide four independent Form C output contacts, voice announced, controllable by DTMF codes.
- .2 Autodialer shall be programmable by means of a standard touch tone telephone. Wiring to Telus Communications demarcation block shall be provided.
- .3 Shall be Barnet Model B1285-M1, B1285-P1 and B-1285-T1.

**20.0 BUILDING LOW
TEMPERATURE
THERMOSTAT**

- .1 Thermostats shall be coiled bulb line voltage type with 0-43⁰C adjustment knob and 22A, 240 VAC (pilot @ 600 VAC) resistance rated form 'C' contact. Thermostats shall be Johnson Controls A19BAC-1. Thermostat anti-tampering clear acrylic guard shall be provided.

**21.0 UNINTERRUPTIBLE
POWER SUPPLY**

- .1 An enclosed dual conversion, on-line type uninterruptible power supply (UPS) with surge protection to IEEE C6241, Cat.A standards shall be provided, complete with 6' cord and plug, optional AS400 alarm dry contact and rated for a maximum

1000VA output capacity. Unit shall be AlwaysOn GES-102N with basic monitoring software, as available from AlwaysOn (1-877-259-2976).)

- .2 A redundant UPS bypass unit rated 16A, 2000VA with selectable automatic or manual transfer shall be provided, also capable of providing 10% voltage regulation from up to 30% supply variation, transient surge suppression of up to 20 kA total peak surge current, include status monitoring lights and communications interface dry contact. Plugs/receptacles for UPS connection shall be provided, but line/load shall be hardwire connected. Redundant UPS bypass unit shall be AlwaysOn BP-12011-ATS-DCC-HW, UPC code 825433-00601-HARDWIRE.

22.0 VOLTAGE

MONITORING RELAY

- .1 Voltage monitor relay 27/47 shall provide undervoltage (27), phase loss, phase reversal & phase unbalance (47) protection. It shall also provide a readable fault memory feature. Relay shall be ABB/SSAC WVM-11AL.
- .2 Voltage monitoring relay shall be installed in a suitable EEMAC 1 enclosure c/w appropriate fusing. Primary fusing shall consist of fuse holders with 35mm DIN rail mounted 'finger safe' rated per IEC IP20, with indicator light and suitable for Midget 38mm x10mm 600 VAC supplemental fuses. Ferraz Shawmut USM-I/A6Y-2B approved..
- .3 Wiring shall be neatly dressed and shall have numbered wire markers. Drawings showing the internal wiring and field connections shall be submitted upon completion.

23.0 EXISTING DCS

PC1555 SECURITY SYSTEM

- .1 Contractor shall modify existing DSC Security system to add within the security system enclosure a 12Vdc relay, 10A, 120V rated form 'C' contact activated by the PGM terminal controller board. This contact shall be utilized for input to the control panel RTU.
- .2 Disconnect the telephone connection to the existing security system and use the telephone line for SCADA alarm.
- .3 Contractor shall conduct 'on-site' final system programming, and provide all necessary field instruction to the District's operating personnel.